HOW TO MINE CRYPTO!

FULL DETAILED INSTRUCTIONS
USE YOUR GPU TO DIG UP BITCOIN & OTHER CRYPTOCURRENCIES

apc

Mar 2018
Issue 452

YOUR EXPERT GUIDE TO TODAY'S TECH

15 WIRELESS ROUTERS TESTED

FIND THE PERFECT WI-FI DEVICE FOR YOUR NEEDS WHETHER YOU'RE ON ADSL, CABLE OR NBN!

STREAMLINE OUR WINDOWS INSTALLATION

AKE WINDOWS LIGHTER ND SPEEDIER WITH OUR COMPLETE GUIDE TO RIPPING OUT THE STUFF YOU DON'T NEED

BUILD A

BULLETPROOF Wi-Fi NETWORK

REVEALED: THE GEAR & KNOW-HOW YOU NEED TO CREATE A STRONG & SECURE WIRELESS NETWORK AT HOME OR WORK

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PRACTICAL TECH TUTORIALS

- → FULLY ENCRYPT YOUR WINDOWS BOOT DRIVE
- → TWEAK AND CUSTOMISE LINUX'S GNOME UI
- → MAKE A MUSIC SERVER WITH A RASPBERRY PI
- → CREATE DIY INTERNET OF THINGS DEVICES

CES 2018: BEST GEAR & TRENDS

WE TRACK DOWN THE TOP TECH FROM THIS YEAR'S CONSUMER ELECTRONICS SHOW IN LAS VEGAS + UNCOVER THE KEY TRENDS THAT WILL SHAPE COMPUTING FOR THE NEXT 12 MONTHS (AND BEYOND!)

EXPERT REVIEWS OF HOT NEW PCs & TECH

- → LENOVO MIXED-REALITY HEADSET: A (MUCH) CHEAPER ALTERNATIVE TO HOLOLENS
- → $500 KOGAN ULTRABOOK: A PREMIUM METAL-BODIED 2-IN-1 FOR 1/4 THE PRICE OF A MACBOOK?
- → LATEST AFFORDABLE SAMSUNG & CRUCIAL SSDS FACE OFF

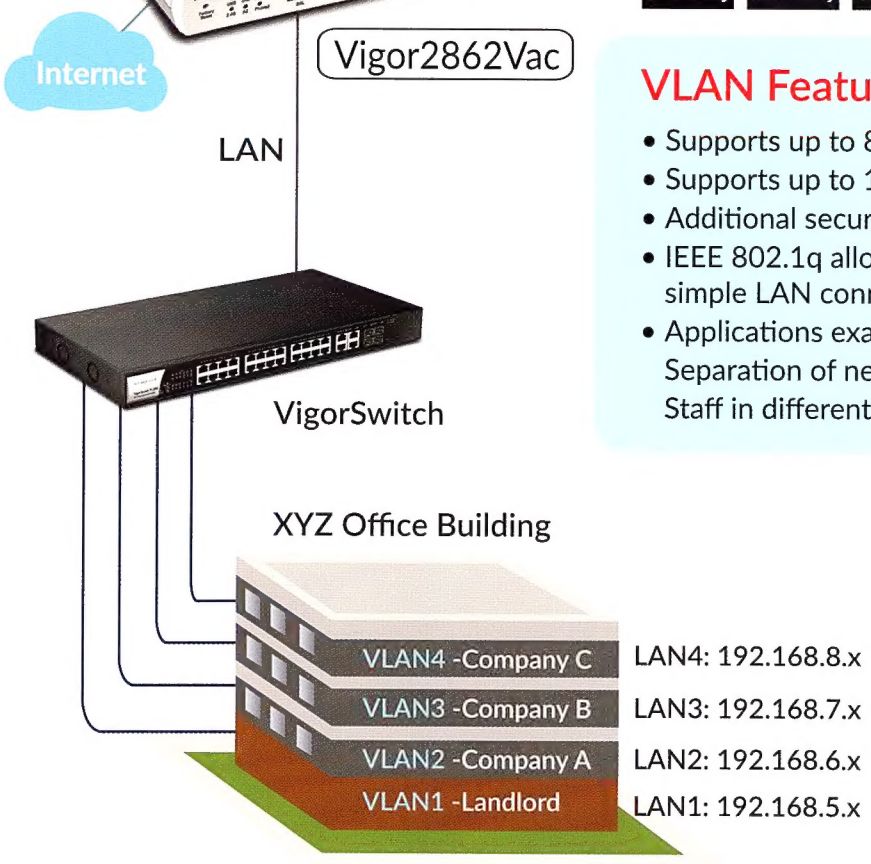
Vigor2862 Series

DrayTek Aust & NZ
www.draytek.com.au

NBN SMB Solution for VDSL2 & Ethernet WAN (FTTN/B, FTTP, HFC, Fixed Wireless, Statellite)

VDSL2/ADSL2+ Multi-WAN Gigabit router with dual USB ports for 3G/4G connectivity, VoIP and IEEE 802.11ac Wi-Fi achieving speeds up to 1.7Gbps throughput

Aust / NZ VDSL NBN Ready | Ethernet WAN NBN Ready | Ethernet WAN UFB Ready | 32x VPN



VLAN Features

- Supports up to 8 LAN IP subnets
- Supports up to 16 VLANs, ie up to 16 logical workgroups
- Additional security and traffic management
- IEEE 802.1q allows multiple VLANs to be connected on a simple LAN connection
- Applications examples:
  Separation of networks for tenants
  Staff in different locations can be grouped as same section

LAN >> VLAN Configuration

VLAN Configuration

☑ Enable

	LAN					VLAN Tag		
	P1	P2	P3	P4	Subnet	Enable	VID	Priority
VLAN0	☐	☐	☐	☐	LAN4	☐	0	0
VLAN1	☑	☐	☐	☐	LAN1	☑	10	4
VLAN2	☐	☑	☐	☐	LAN2	☑	20	1
VLAN3	☐	☐	☑	☐	LAN3	☑	30	2
VLAN4	☑	☑	☑	☑	LAN4	☑	40	3

- VDSL2/ADSL2+, Gigabit Ethernet WAN port, Dual USB ports for failover and load-balancing
- Two USB 2.0 ports for connection to two 3.5G/4G LTE USB mobiles, FTP server and network printer
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- Integrated IEEE 802.11ac (AC2000) wireless Access Point; dual band; up to 1.7Gbps throughput (ac & Vac model)
- IPv6 & IPv4. Increased IP addresses (1022) and IP subnets (8)
- VoIP (2 x FXS and 1 x FXO Line Port) for Vigor2862Vac
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- High Availability mode
- 16 x VLANs for secure and efficient workgroup management
- 32 x VPN tunnels (including 16 x SSL VPN tunnels)
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- Embedded Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of multiple wireless VigorAPs
- Works with Smart Monitor Network Traffic Analyzer
- Works with VigorACS 2 Central Management for multi-site deployment

i-LAN TECHNOLOGY

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The great crypto debate

APC's editor ponders the age-old question: "To mine or not to mine?"

We've covered Bitcoin more than a few times in the pages of *APC*, but the last nine months or so has seen the craze over cryptocurrencies reach new heights (before then plunging again to new depths). They've been called pyramid schemes and economic bubbles by notable economists, but that doesn't seem to have done much to dampen enthusiasm, as every man and his dog wonders whether they should buy up some cryptocurrency as an investment.

This being *APC*, we're a bit more interested in the technical side of things and, specifically, whether it's still worth mining crypto on your desktop PC – it is, after all, a relatively risk-free way of speculating, as, if you've already got a half-decent graphics card, you're not putting any real money on the line – barring the cost of the power you use.

If you don't have a decent GPU, Australia's graphics card market thankfully hasn't been hit too hard by the crypto craze either – while graphics card prices haven't really dropped in the last 18 months, by and large, they at least haven't increased drastically either. We'd recommend choosing one with a good cooler, as mining is thirsty work.

So what should you mine? Well, while our how-to on page 66 deals specifically with Bitcoin, once you're set up to mine one cryptocurrency, it's pretty simple to just change a few settings to switch over to another. As with any kind of long-term investment, if you're going to get into crypto mining, then it's a good idea to diversify – it's very difficult to predict which currencies are going to thrive, and the volatility of Bitcoin should demonstrate to everyone that you should probably pick a point at which you're happy to cash in and stick to it. The major currencies are currently Ethereum, Bitcoin Cash (a fork of the original Bitcoin) and Ripple (or specifically XRP), with a smattering of half a dozen more-established others alongside a bucketload of up-and-coming currencies. Given the ease with which you can jump from mining one cryptocurrency to another, I'd suggest picking a few and spending alternating weeks on each, which will give you a nice diverse portfolio – and, therefore, the best chance of getting a decent return on your time investment. ■

DAN GARDINER
EDITOR-IN-CHIEF
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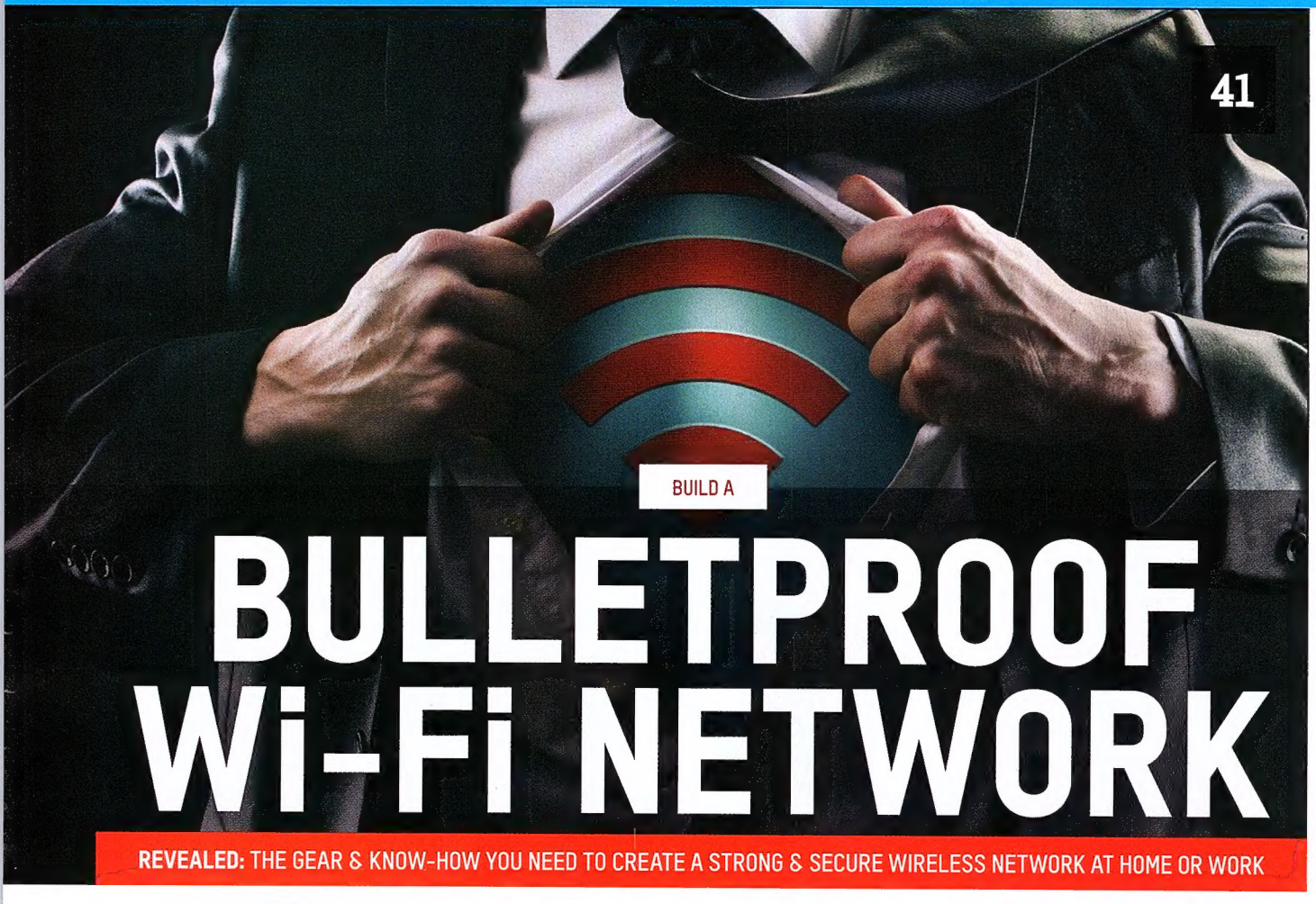

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Please note that these exclusive *APC* & *TechLife* magazine downloads will only be available for a limited time, from **01/03/2018** to **18/04/2018**

EXCLUSIVE GIFT 01

FULL VERSION WORTH $40

GET WINDOWS RUNNING THE BEST THAT IT CAN

Optimise your experience with Ashampoo Win Optimizer 2018

FULL VERSION WORTH $40

Ashampoo WinOptimizer 2018 cleans, accelerates and secures your Windows system. The program takes care of maintenance issues that arise from regular Windows use. Tools such as one-click optimisation declutter hard disks, repair invalid shortcuts and delete the browsing history and cookies to save space and protect your privacy. Various modules help analyse, customise and optimise Windows systems.

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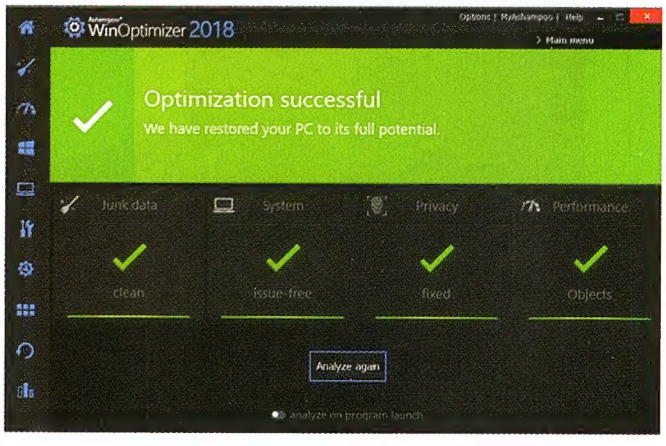

EXCLUSIVE GIFT 02

FULL VERSION WORTH $30

TAKE FULL CONTROL OVER YOUR WINDOWS BOOT-UP

Eliminate bloat and streamline work with Abelssoft StartupStar

FULL VERSION WORTH $30

StartUpStar eliminates startup irritants! It's an almost universal problem on Windows PCs — unneeded programs that run on startup, adding extraneous time to the boot process. How does one stop these pesky programs from doing this? StartUpStar from Abelssoft has a solution. The program presents you with a list of startup items, and then lets you decide which ones to keep or remove. Easy.

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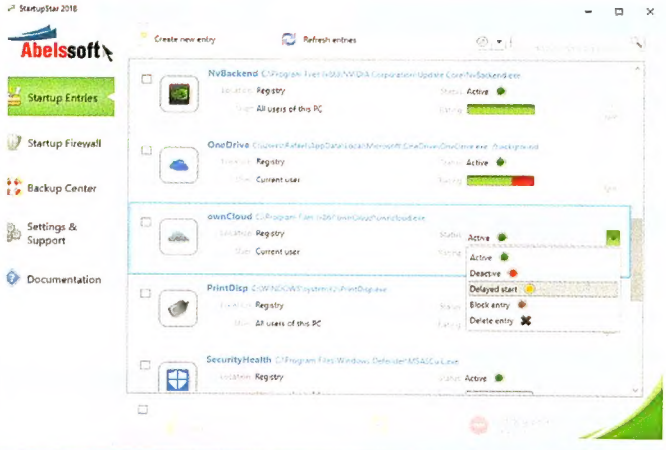

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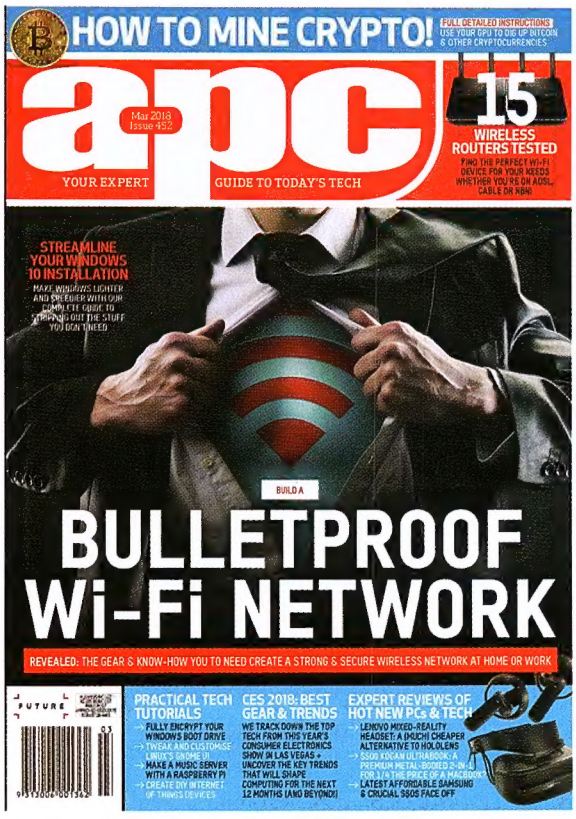
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Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine — having been consistently in print for over 35 years, since our first issue way back in May 1980 — and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer — it's in our name, after all — the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, *APC*'s journalists want to know what's good in tech — no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives — the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

technotes

» NEED TO KNOW

Telstra and Optus announce a 2019 rollout of 5G fixed wireless

NEW TECH TO BE TESTED AT THE 2018 GOLD COAST COMMONWEALTH GAMES.

Telstra and Optus have partnered with the Commonwealth Games to test their 5G technology, with the former setting up a 5G Innovation Centre in the host city to conduct trials from. Meanwhile, Optus will provide the digital infrastructure needed for telecommunication services at the Games, ranging from telephony to cloud storage. Both telcos have also announced that they will be ready to begin the rollout of their 5G network to the public in 2019, with Optus promising a start early next year. SS

Samsung is making processors dedicated to crypto mining

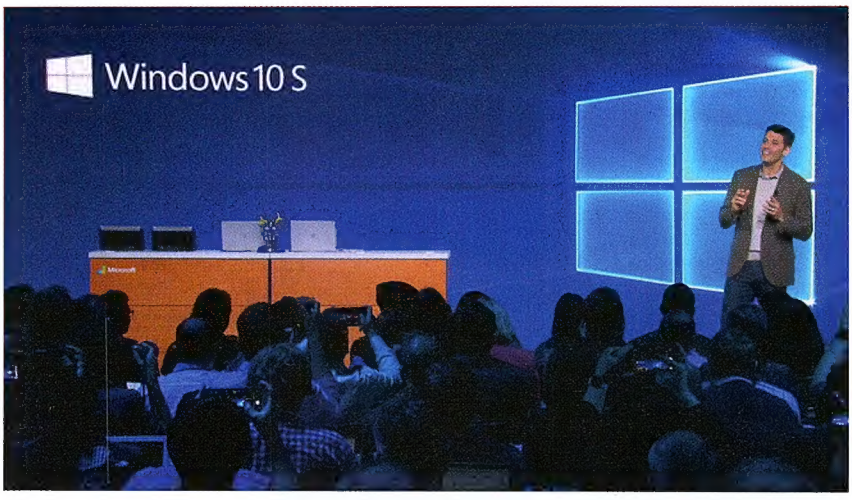
ASIC CHIPS DESIGNED SPECIALLY TO MINE BITCOIN.

Samsung has confirmed that it's "engaged in the manufacturing of cryptocurrency mining chips". Although no other details have been revealed, it has been reported that Samsung will produce application-specific integrated circuit (ASIC) chips designed for that single task. This could ease the pressure on GPU stocks and inflated costs, bringing much-needed relief to PC gamers. Even though the South Korean company is best known for its phones and home appliances, it recently toppled Intel as the world's largest chip manufacturer. SS

'Hazardous gaming' and 'gaming disorder' on WHO's disease list

INTERNATIONAL COMPENDIUM GETS GAME-RELATED UPDATE.

The World Health Organisation has released a beta version of its updated International Compendium of Diseases online, and the latest list includes "hazardous gaming" and "gaming disorder". These new entries are listed under the addictive behaviours category, putting gaming addiction on par with substance addiction and gambling. SS



Windows 10 S to become Windows 10 S Mode

Microsoft is revising its approach with the lightweight version of Windows.

Changes are coming to Windows 10 S – the stripped-down, lightweight operating system that's said to provide improved battery efficiency and security, albeit at the expense of the platform's traditional openness. For one, it's getting a new name, with the operating system said to become Windows 10 S Mode in the not-too-distant future.

That's according to the Microsoft watchers at Thurrott and Neowin, who say the company wants to rebrand the software to better fit into its portfolio of products. The new S Mode OS will soon be available on most versions of Windows, limiting users to apps downloaded through the Windows Store, with an unlock option available for the full version of the software.

Apparently, if you're running Windows 10 Home in S Mode, you'll be able to upgrade to the full desktop experience for free, while those with Windows 10 Pro in S Mode are going to have to cough up US$49 for the privilege of unlocking. Microsoft has remained mum on the matter, stating "We'll share more about what's next for Windows 10 S when we're ready." David Nield

Chinese street cops are using augmented reality glasses to identify criminals

WELCOME TO OUR CYBERPUNK FUTURE, TODAY.

Just ahead of Chinese New Year, China's state media recently reported that the country's railway police in Zhengzhou have started using AR glasses equipped with facial recognition capabilities. With more than 389 million train trips expected for the holiday period, Chinese authorities are hoping that the glasses, which are connected to the police database, will catch known criminals, spot impostors and generally help to verify passenger identities. The technology apparently lead to the identification of seven suspected criminals in the first week of operation, with charges including hit-and-run and human trafficking. While privacy and security concerns are being raised over a national database that would contain the personal info of over 1.3 billion citizens, the Government and partnering tech companies continue to focus on AI development, with a $2.7 billion AI research district in Beijing expected to be operational by 2025. AI-based facial recognition is already being used in Shanghai for traffic violations and certain other train stations around the country, but the development of AR glasses will allow these scanners to go mobile. Harry Domanski

Nvidia says "gamers come first" as it moves against cryptocurrency miners

No more bulk ordering GPUs?

As cryptocurrency miners once again push the prices of graphics cards up – and even drive some GPUs out of stock – Nvidia is asking retailers to sell a maximum of two graphics cards (of the same model) per person in an effort to cut back on bulk orders.

In a comment to German tech site ComputerBase, the company said: "For Nvidia, gamers come first. All activities related to our GeForce product line are targeted at our main audience." While this limitation is just a suggestion for retailers, the GPU manufacturer is hoping the request will help address supply and pricing issues with the cards, which are climbing to prices as high as twice the RRP in some instances.

While there are dedicated systems available now for mining certain cryptocurrencies (particularly Bitcoin), in order to harvest the likes of Etherium and other emerging currencies, people are still building their own rigs in which GPUs play a crucial role due to their capacity for labour-intensive operations. For more on cryptocurrency, head to our 'How to mine Bitcoin' feature on page 66. **Harry Domanski**

Spectre and Meltdown headaches continue for hardware and software makers

MICROSOFT RELEASES EMERGENCY PATCH AFTER INTEL ROLLS ITS LATEST ONE BACK.

In January, the discovery of serious flaws in the design processors used in millions of devices around the world had both chip-manufacturers and software-makers scrambling to releases patches to counter the threats. Although Intel released updates and promised that all its devices would see fixes rolled out by the end January, the company's most recent patch for Spectre embarrassingly had to be rolled back because of reboot issues. "I apologise for any disruption this change in guidance may cause," said Neil Shenoy, Intel's Executive Vice President, in a statement. Soon after Intel's public withdrawal of the patch, Microsoft released its own stop-gap update for Windows, which is designed to mitigate Spectre bugs until Intel comes up with a fix that works.

Meanwhile, security firms are reporting that there are already hundreds of pieces of nonfunctional Spectre and Meltdown malware circulating, which seem to be probing the exploits — test runs, it's likely, to be followed by more serious and 'armed' malware that could do real damage. Get your gear patched wherever possible, folks. **Dan Gardiner**

Queensland police to use VR to learn how to fight terrorism

PART OF A $46.7 MILLION TRAINING HUB.

A 140-hectare Westgate complex in Wacol is in the process of being refurbished for the use of Queensland Police, who'll use the upgraded facility to train for anti-terrorist events and other related emergencies. The plan currently involves the use of virtual reality headsets throughout the scenario village, which features such areas as a train station, pub, caravan park and shopping mall, as well as private houses. **HD**

Chat app Telegram pulled from iOS App Store over child porn allegations

THE PITFALLS OF ENCRYPTION.

Late in January, the encrypted messaging service Telegram was temporarily removed from the iOS App Store and, according to a report from 9to5Mac, this was due to allegations of child pornography on the service. After it was reported, the app was immediately taken down from the App Store. Telegram was quick to ban the users who uploaded the content in question, and a new version of the chat app — one with safety measures in place that are believed to prevent illegal material being uploaded in the future — has been allowed to return to the Store. **HD**

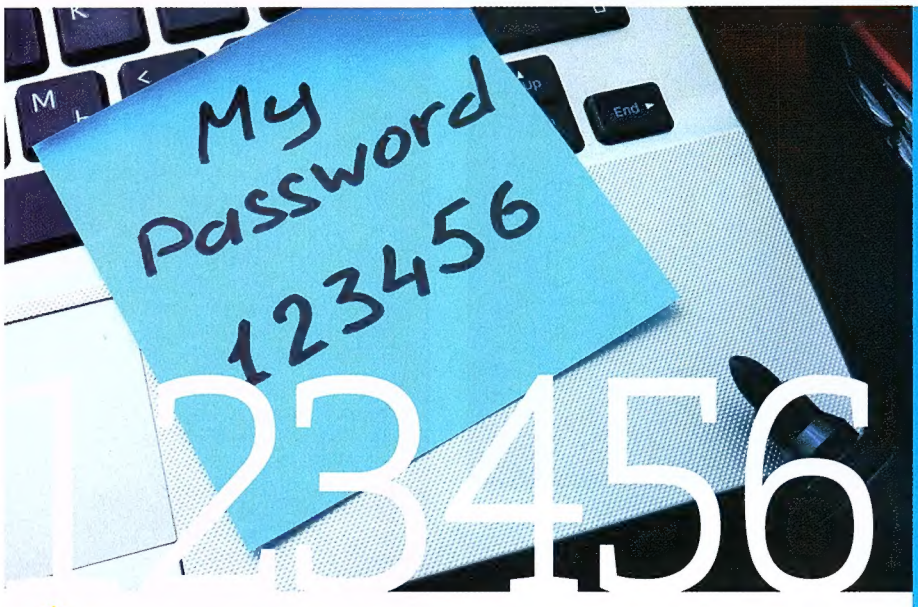
Australia's fastest NBN plans may face the chopping block

100MBPS IS LOOKING LESS ATTRACTIVE THAN EVER.

NBN Co announced wholesale discounts on its higher-tier plans late in 2017 in order to convince more customers to take up the 50Mbps option, and most major telcos have reduced their rates on this speed as a result. Considering that both Optus and Telstra have already been forced to compensate thousands of customers for promising speeds that most users couldn't achieve, it's unsurprising that the popularity of the 100Mbps plan has suffered as a result. **HD**

numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS



THE WORLD'S MOST POPULAR PASSWORD FOR THE FOURTH YEAR IN A ROW

In 2013, 'password' was overtaken as the world's most commonly used password and supplanted by '123456' and, according to security software company SplashData, the popular numerical sequence has maintained its throne now for the fourth year running. While the eponymous 'password' remains in second place, it is followed by some other deeply obvious options, with '12345678' in third place, 'qwerty' in fourth, '12345' in fifth and '123456789' in sixth position. So if you're using any of these... please don't.

64%

AMOUNT OF SMART SPEAKER OWNERS WHO SAY THAT THEY'RE USING THEIR SMARTPHONES LESS

A global survey conducted by research group Accenture has found that almost two-thirds of the respondents that use a smart speaker are using their smartphone less as a result. This usage doesn't just stop at general questions such as "How's the weather?" either; it includes the decline in smartphone-based entertainment and online shopping as well. The survey has also found just how much smart home device adoption is climbing, with an impressive rate of 50% growth in the category year-on-year.

39

NUMBER OF LENOVO LAPTOP MODELS THAT SHIPPED WITH FLAKY FINGERPRINT ENCRYPTION SOFTWARE

If you've got a Lenovo laptop with a fingerprint scanner, it would be wise to upgrade your Fingerprint Manager Pro software (you'll want a version of 8.01.87 or higher) as it's recently been revealed that older versions of the app that shipped with 39 models of laptop are insecure. Not only did the fingerprint software utilise a weak encryption algorithm, but it also included a hardcoded password that allowed users with local system access to view the encrypted data.

$118 million

EARNINGS FROM AUSTRALIAN GAME DEVELOPERS IN THE 16/17 FINANCIAL YEAR

A recent report released by the Interactive Games & Entertainment Association on the Australian game development industry has found that, despite little support, the field has remained relatively stable — it actually grew a little, in fact. While the '15/16 financial year saw the field's total revenue cap at just under $115 million, the following year has grown to $118.5 million, with 80% of that coming from overseas sales, especially from the US. The number of full-time employees has also risen from 842 to 948, with the industry predominantly made up of men — only 19% identify as female.

1 Flick

FACEBOOK INVENTS A NEW UNIT OF TIME

Facebook's virtual reality team, Oculus, has invented a new unit by which to measure time — the Flick. The unit equates to 1/705,600,000 of a second (less than one seven-millionth of a second) which is a fraction that happens to be a very neat factor of numbers such as 1/23.976, 1/25, 1/30, 1/44.1, 1/60 and so on. These are all common framerates and frequencies used for various formats of media (30fps video, 44.1KHz audio, for instance). As many of these fractions would otherwise translate to recurring decimals, the Oculus team hopes that the Flick will make media processing more harmonious and tidy. ■

techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

Smart tech playing the snitch

The everyday devices in our pockets are capable of much more than sending ~~dick~~ duck pics.

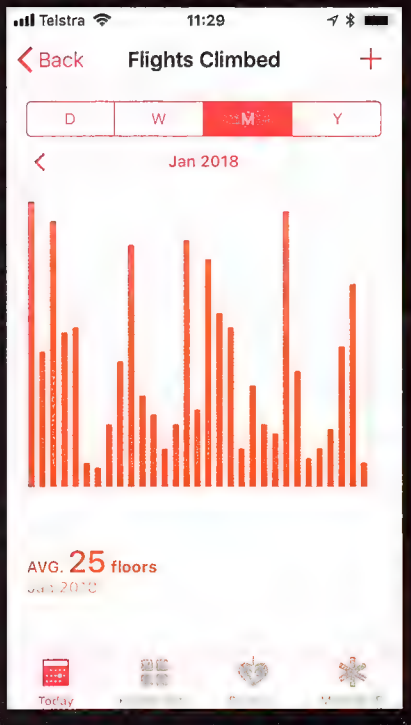
Been thinking about committing a crime recently? Well, firstly... don't. Secondly, you might want to reconsider the presence of certain smart devices on or around you. Whether it's your handy-dandy smartphone, your pacemaker, your step-tracker or even your smart speakers, today's technology can sneakily work against you if you decide to do something naughty. Not only can they assist law enforcement agencies with digital evidence after the event, they can also help you track down thieves! This month, we look at the everyday smart tech whose basic services and apps would make Poirot's moustache curl just that *little* bit more...!

Fly-on-the-wall smart speakers

We reported back in issue 445 (page 114) that a smart speaker had called the police during a domestic violence incident in New Mexico, allowing authorities to break up the fight. Well, an Amazon Echo could now hold vital evidence in an Arkansas murder case, as the device records what it hears after a trigger phrase. The suspect is accused of strangling and drowning his friend Victor Collins in his hot tub.

Pacemaker foils insurance fraud

Early last year, US investigators used data gleaned from a man's pacemaker to lay charges of aggravated arson and insurance fraud upon him. The 59-year-old had claimed to be asleep when his house in Ohio caught fire, allowing him only moments to grab a few things and jump out of a window. However, the pacemaker revealed he had been active at that time, leading police to build a case against him.



Tracking app reveals location of body

Back in 2016, Carla Melendez booted up Find my Phone to reveal the location of her husband. Noticing that he was in an unfamiliar location and for an unusual amount of time, she went to find out what was going on, only to find his body. The following police investigation built a case around the deceased man's friend and authorities have charged him with murder.

Fitbit reveals true time of death

US authorities found the body of Connie Dabate in her house's basement. Her husband, who had been found bloody and cable-tied to a chair, claimed that a masked intruder was to blame. However, after finding no such man, the police scrutinised data from Connie's Fitbit and determined that, at the time of the alleged intruder's attack, she was actually walking around the house, leading them to suspect her husband instead.

Apple Health app snitches on suspect

German police are calling on an iPhone as a prime witness in a rape-murder case in Freiburg. While the details of the case haven't been made public in their entirety (as it's currently ongoing), the stock Health app supposedly provides digital evidence suggesting that the suspect was "climbing stairs" at the time the police allege he climbed down a steep embankment and threw the body of his 19-year-old female victim into a river. We hope they have more to go on than that... ■

gadgets

» GEAR WE WANT

NEBULA CAPSULE PROJECTOR

Drink up this portable projector.

US$350 | SEENEBULA.COM

As one of the most highly-funded IndeGoGo campaigns to date, this Coke-can-sized projector may be one of the most successful 'fizzer's' we've seen. Having reviewed a few pocket-sized projectors in recent months, the Nebula's 100 lumen peak brightness, WVGA 850 x 480-pixel resolution and 20- to 100-inch screen size sound pretty bog standard to us... so there must be something we're missing, 'cause this can is shaking up some serious support. That said, the US$350 price is fairly reasonable and its 2.5-hour battery life at peak brightness is slightly above average, although we do worry that the omnidirectional speakers will just divert limited sound from an otherwise very small audio driver. **JB**

NANOLEAF LIGHT PANELS

Let there be light!

FROM $300 | NANOLEAF.ME

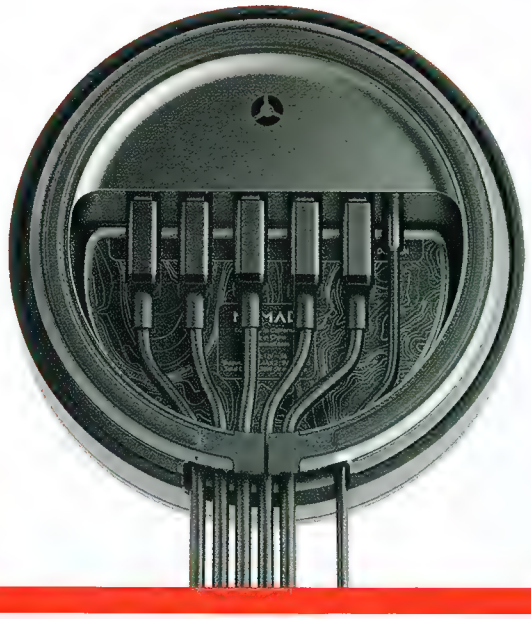
These triangular LED panels (measuring 24cm on each side and a nicely slim 8mm in depth) slot together using linkers, with a trapezoidal controller that can pop into any of the panels, meaning it offers great flexibility in terms of creating your desired shape. Grab the Nanoleaf app, pair your phone, then get the party started. There are a bunch of preloaded moods in the app that you can play around with, but there are many more to download, or even create your own, tweaking brightness, hue and pulse. Having these panels up on the wall of your house really does set the scene, lending your abode a distinct modern feel, and they're capable of spreading the light evenly through a room, regardless of your chosen design. The additional Rhythm attachment, which 'listens' to environmental stimuli (music, for instance) and reacts by pulsing the light in unison, adds an extra dimension to the experience. Very cool. **CS**

DJI MAVIC AIR

The new standard in consumer drones.

$1,299 | WWW.DJI.COM

DJI's latest consumer drone bundles unprecedented portability with a compact high-resolution camera to make for one of the most convenient drones available. The new foldable wing design gives the unit a footprint that's only about a centimeter wider than a Samsung Galaxy Note 8 smartphone and it's 12MP gimbal-stabilised camera can shoot up to 4K @ 30fps, or 1080p @ 120fps slow-motion video footage. The Mavic Air also features the company's leading obstacle-avoidance technology, automatic object tracking and a suite of cinematic filming routines that claim to provide stable professional shots at the push of a button. **JB**



NOMAD USB HUB WIRELESS

Move over to wireless charging.

US$79.95 | WWW.HELLONOMAD.COM

With Apple jumping on the Qi wireless charging bandwagon, there's now a much bigger number of devices out there that can utilise the new charging format. We're not quite behind the days of cable charging, however, with the vast majority of our devices still requiring a USB-connected cable to juice up. That's the logic behind Nomad's Qi and four-port USB charge dock, which mixes the best of both interfaces to accommodate all your portable doodads. The Nomad's 7.5W wireless output isn't quite up to the 15W output you get from the leading Qi wireless chargers, but the inclusion of one 2.4A USB, two 1A USB and one USB Type-C connections give you an excellent range of cabled options, meaning you could charge pretty-much everything you own all at once. **JB**

EVERYSIGHT RAPTOR AR SUNGLASSES

The sunnies for the data nerds.

US$499 | EVERYSIGHT.COM

Not every cyclist cares about metrics or how well they're performing, but if you're the type of road or MTB rider who lives to beat your best on your favourite routes and enjoys digging into ride data, you'll get along with Everysight's Raptor AR Sunglasses. These smart shades monitor your ride, presenting a wealth of useful metrics without the complex setup. There's built-in GPS and sensors that capture, then display, riding information in real time, right on the lens – get an eyeful of navigation, time, distance, speed, cadence, power and other metrics. You can upload your rides to **go.everysight** and share them to Strava. If you find yourself on a scenic route, take HD photos and videos with just a tap of the Raptor glasses or use the voice command feature. One for road and mountain cyclists who love geeking out over ride metrics and sharing it.

ROTO VR CHAIR

The virtual reality fan's throne.

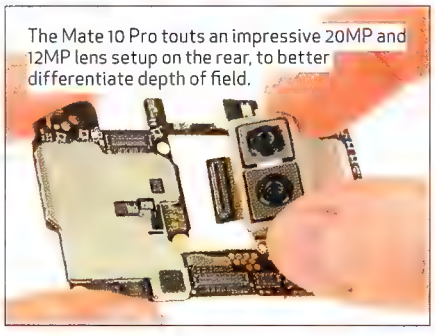
FROM US$999 | ROTOVR.COM

"You spin me right round, baby..." sang Dead or Alive, who, except for the fact that their song dropped in 1984 and we're in 2018, could have been singing about the Roto VR Chair. Why? Swivel action base. That doesn't mean you'll end up in a tangle of cables, though – plug your PC into the back of the chair instead! The Roto VR Chair wants to provide you with a more immersive AR or VR experience, helping you explore 360 degrees without your feet touching the floor, while motorised turns work to provide a sense of weightlessness. The starter pack includes the chair, base, head tracker and touch pedals, enabling you to walk in a virtual environment even when seated. It also promises to combat motion sickness, which is good news for those susceptible to the queasies. A winner for people craving comfort and gravitational presence in the virtual world.

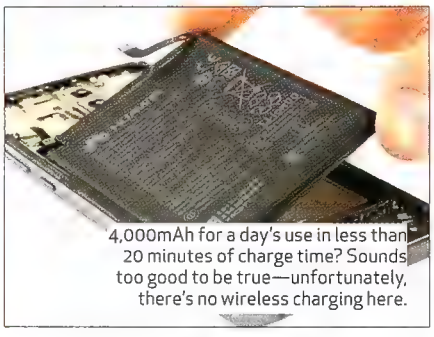
howit'sdone

Huawei Mate 10 Pro

That's the Huawei to do it!



The Mate 10 Pro touts an impressive 20MP and 12MP lens setup on the rear, to better differentiate depth of field.



4,000mAh for a day's use in less than 20 minutes of charge time? Sounds too good to be true—unfortunately, there's no wireless charging here.

MAJOR TECH SPECS

- Octa-core Kirin 970 and Mali-G72 MP12 GPU
- 6.0-inch 1,080 x 2,160 (402 ppi) AMOLED display
- Dual 20MP and 12MP f/1.6 main camera unit by Leica
- 8MP f/2.0 selfie camera
- 128GB storage and 6GB RAM, or 64GB storage and 4GB RAM
- Android 8.0 Oreo and EMUI 8.0

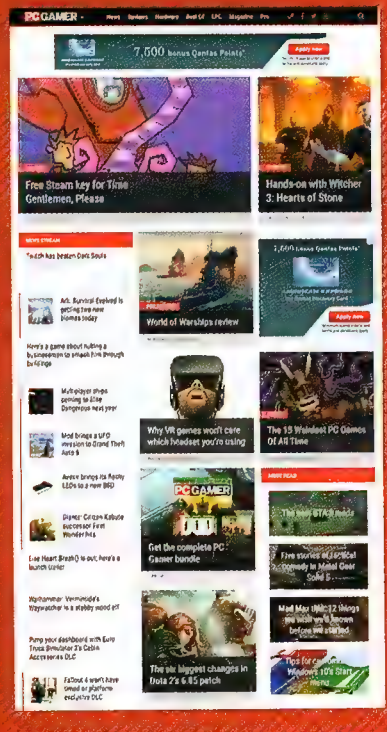
KEY FINDINGS

- Before we deconstructed the Mate 10 Pro, we lined it up next to its older brother the Mate 9. At first glance, differences are minor: there's the new Leica dual camera with optical image stabilisation, and the round fingerprint sensor below. More noticeable is the ergonomic curved glass back and a signature stripe highlighting the dual-lens camera. You may notice that the Mate 10 Pro is slightly smaller, too – although the display is 2mm bigger. The new 6.0-inch display is nearly bezel-less.
- In the absence of twistable fasteners, we drop an iOpener and start heating the back of the phablet. Given that IP67 rating, perhaps we should expect trouble. Surprisingly, the heated adhesive doesn't stick too well to the back cover, and with the use of some Opening Picks, we separate it from the main body. Like the Mate 9, the 10 Pro's fingerprint flex cable still tethers the back cover to the rest of it.
- The Mate 10 Pro's valuables are well protected, and covered with a large metal shield. We remove one of the many liquid indicators and all the Phillips screws we can find, as well as a small metal shield covering the fingerprint sensor flex connection. The screws seem to be some kind of aluminium alloy – they don't attract much to any of our driver bits, nor to the magnetic mat. With everything unscrewed, next to come out is the large shield holding the dual-LED flash, which protects all flex connections and contacts on the motherboard.
- We're excited to cleave our way to the motherboard, but first, we spot something worthy of a detour: the battery! A big slab of adhesive spans nearly the entire bottom of the battery. With some heat and help from an iFixit Plastic Card, we can extract this 4,000mAh beast. With its 3.82V and up to 15.3Wh of power, it's the same as in the Mate 9. It's coupled with smart battery management that learns from user behaviour to minimise wasted power and maximise battery life. Huawei promises a full day of use with just a 20-minute charge.
- **Repairability Score:** 4 out of 10 (10 is easiest to repair). Despite the IP67 seals, the back cover is simple to open. The USB port, loudspeaker and mobo are easy to remove. The Mate 10 Pro has very few screws, all standard Phillips, but unimpressed by magnetism – except one, buried beneath the display. With only one big cable, the Mate 10 Pro is cleanly arranged – though that cable is soldered to the USB port. A damaged front camera means switching the whole display, including the frame, or damaging the display while trying to remove it. And replacing the display – the most common repair – means taking out almost every component. ■

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: **www.ifixit.com**

SMARTER COOKIES ENABLED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epinions

POWERLINE NOT JUST "PLUG AND GO"

I was recently reading your Xmas issue (*APC* #449) and came across the TP-Link TL-PA8010P on page 62, which won the award for 'Best powerline kit'. Your assertion of just "plug them in and hit the button" does not always result in a working setup.

As an electrician, I have come across several instances of people not being able to get a connection. The problem occurs when the two power outlets concerned are on separate circuit breakers in the main box.

The signal will not connect through the breaker and RCD from one circuit to the other. Fitting a new outlet, so both devices are on the same circuit, will set things right.

This little problem has occurred with TP-link and D-link kits. Hope this is of some help.

Mike Iverson

Ed replies: *Yep, that's the common technological shortcoming of all powerline kits, no matter what the brand – not just those from D-Link and TP-Link – and it's something we've highlighted in many of APC's round-ups and standalone reviews over the years. We didn't have room in the short 'award' blurb to discuss this particular bit of powerline wisdom, but it's definitely worth re-iterating every now and again – so please consider it suitably re-it! (That's a word, right, chief sub?)*

"The signal will not connect through the breaker and RCD from one circuit to the other."

RE-TUNING ONENOTE

Just wanted to share a quick fix to a problem with Microsoft's OneNote (2016) that I've been having, where the search function stopped working on all three of my synced computers after the last Windows update.

I found the following suggestion online and it has worked. One would think Microsoft would test their major programs... Ho hum.

1. First things first, close OneNote if it is open.
2. Navigate to C:\Program Files (x86)\Microsoft Office\root\Office16\ and find the file called onenote or onenote.exe (note that this is in the Office16 directory, not the Office16\OneNote directory).
3. Right-click the file and select 'Troubleshoot compatibility', then follow the prompts.

In my case, the wizard did its thing, reverting the onenote.exe file to Windows 8 compatibility, which sorted the problem.

Dr. Igor Jakubowicz

Correction

In last month's issue of *APC*, we printed an image of a rather charming yellow remote-controlled boat as part of our Techbrief (see *APC* #451, page 11) discussing AI as a force for good. We neglected to provide the necessary accreditation for this image — it is copyright the Government of South Australia's Department of Environment — for which we apologise. The Q-Boat, as it is named, is used in conjunction with attached sensors for the purpose of monitoring water, its depth and flow, and supports planning and management throughout the state of South Australia. All this data is then processed using industry-specific software to produce a map or refined information for further analysis. For more information on the Q-Boat and water monitoring in general, head here: **tinyurl.com/apc452-qboat**

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

enduser

» SHAUN PRESCOTT DIGS INTO THE BIG TECH ISSUES AFFECTING CONSUMERS

Is social media this century's tobacco?

A growing number of tech insiders are warning about the addictive design of social media, writes Shaun Prescott.

Five years ago, you might have been forgiven for not being particularly concerned about any potential pitfalls of social media. Sure, powerful companies may retain your data and use it in various benign or nefarious ways, but at least you weren't left out of parties. Over the last year or two, though, it's become far harder to partake without a dark cloud lingering over it all. Whether it be internet addiction or the very real fact that whole election campaigns can be manipulated here, people tend to be more circumspect about social media nowadays (though usually not so much that they'll cut their ties forever – if that's possible).

Some of the folk who were actively involved with the creation of Facebook and Google have formed a new group called the Center for Humane Technology (CHT), which will campaign against tech addiction and other undesirable byproducts of our digital age. And it's little wonder, with so many alarming trends emerging in recent months, whether it be the election interferences, or the proliferation of YouTube videos aimed at kids featuring inappropriate – and often algorithmically generated – content.

Speaking to the *New York Times*, former Google ethicist and leader of the Center for Humane Technology, Tristan Harris, was pretty blunt: "The largest supercomputers in the world are inside of two companies – Google and Facebook – and where are we pointing them? We're pointing them at people's brains, at children."

As you can probably tell, much of the focus for the CHT is on saving kids from the perils of tech addiction. An early Facebook investor, Roger McNamee, was similarly unrestrained: "Facebook appeals to your lizard brain – primarily fear and anger. And with smartphones, they've got you for every waking moment."

In the wake of the *Times*' article, many have held forth about how personal responsibility should prevail over any attempt to legislate limits on social media use for children, or else regulate it in other ways. And while personal responsibility is definitely important, children will have almost no option. Social media is as much a part of our daily ambience as cigarette smoke was in the 1970s, and the anxieties, fears, pressures – not to mention the effect Facebook can have on swaying public opinion – brought to bear on children will not be a choice *they* make: it'll have been *our* choice.

A recent *Guardian* report pointed out that many top Twitter executives don't actively use the website – or else, they use it in a much more moderate way than others. For those building these powerful platforms, the immensity of their influence is abundantly clear: they've got access to the stats, after all. But for the rest of us (those of us who don't care if Zuckerberg has our baby photos as long as he doesn't share them with Russians), we can hardly imagine how these platforms will affect humankind in the coming decades. Assuming we're still around. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Head to head: Wired vs wireless gaming mice

Alex Cox rolls up his sleeves, cracks his knuckles and sits down at his gaming PC to find out once and for all which mouse is mightier.

Wired: What is a mouse without its tail?
Wireless: All mice deserve the freedom of wireless.
Wireless charging: Keep your mouse powered up without any effort.

We've come a long way from Xerox's three-button box with wheels on the bottom, but while there's a lot more to choose from, the importance of the mouse hasn't diminished. So which to choose? We're smashing the three pillars of mousing against each other: the traditional, standard wired mouse; the pretty-much-standard wireless mouse; and the new kid on the block, the wireless charging mouse. Should you stay with what works, pick freedom over tethering or empty your wallet in pursuit of a mouse that charges itself? Let's find out...

Round 1

CONVENIENCE

As with any attempt at making comparisons between competing standards, a great many of these categories will be highly subjective – and here's the first. A wired mouse is fundamentally less convenient than a wireless one, right? By virtue of the fact that you can't up and leave your desk with it, or pick it up and hurl it at a wall, without it pinging back on its own umbilical cord? Well, yes, and there are also less stupid reasons to appreciate wireless mice. Some are Bluetooth compatible and can also interact with your smartphone or tablet, as well as your PC. The lack of a cord means you'll never get tangled or snagged at the worst moment. Wireless mice are pretty awesome, both more and less so when a charging pad enters the fray. More, because you never run the risk of running out of battery power at the worst moment, and less because that expensive mat becomes an essential part of your mousing activities. But there's a reason that wired mice still exist: You can plug them in, and they enable you to point at things without any further fuss. No losing of dongles. That counts for something, at least.

WINNER
Wireless

Round 2

LATENCY

The obvious, and actual, winner of the low-latency wars is the good ol' wired mouse. The speed at which signals can travel along a wire from your mouse to your PC, and subsequently be interpreted into movements, is fundamentally faster than any wireless solution. But not by much, in real terms. Contain your rage, but we're going to say it: Bluetooth's lag is only just perceptible. Most traditional RF wireless solutions manage a speed that, to the untrained eye, is completely instantaneous. And new technologies are arriving that drop the interpretation interval even further – Logitech's Lightspeed wireless communication, for example, purports to offer a 1ms latency. We've tested it, and we believe it; essentially, any reason you might have had to avoid wireless based on its sluggishness is quickly dissipating, even if you're a gamer with lightning reactions. Since we ought to mention it, wireless charging makes no difference to latency, or at least it shouldn't. Logitech's own charge pad, the Powerplay, includes a passthrough for a Lightspeed receiver, although not every charging solution will incorporate such tech.

WINNER
Wired

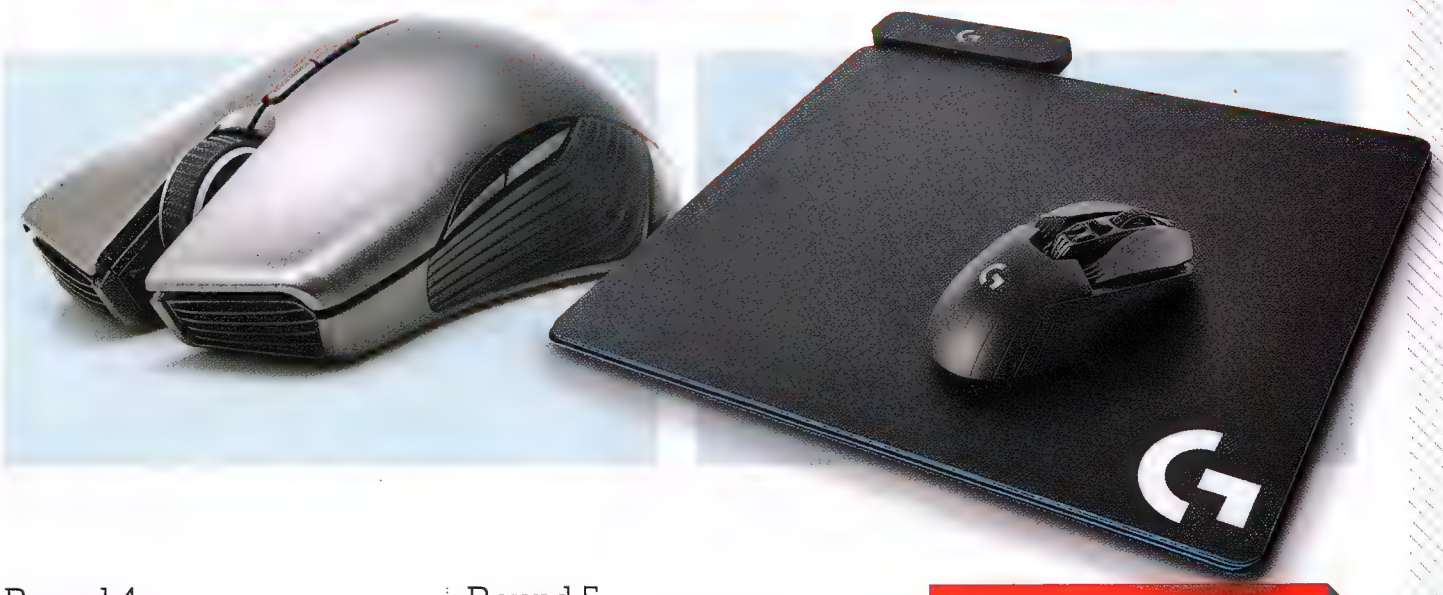
Round 3

RELIABILITY

Time for a bit of a tenuous argument? Why not. But let us begin with the truth: Wireless mice are the least reliable option. While interference is rarely an issue, and most broadcast systems can cope with a decent distance between mouse and receiver, the threat of disconnection is there. Worse: sometimes batteries run out, and usually this happens at the absolute worst moment. If you're using a mouse with AA cells, you can switch them out quickly; with an internal lithium battery, you can generally plug in and switch to wired mode while charging. Both solutions are quick, but neither situation is ideal. And if you charge via a dock... session over. Wired mice are far more reliable. Until something happens to the cable. Most wired devices are hard-wired, so unless you're adept with a soldering iron and a multimeter, a shredded cable means a new mouse. That infrequent, unlikely situation is why wireless charging wins this category for us. There's no risk of a flat battery, a natural encouragement to keep your mouse close to the receiver, and no cable to get eaten by your dog. A wirelessly charged mouse is always ready to go.

WINNER
Wireless charging

"Going wireless means making sacrifices, no matter how small, and the minuscule chance of your cord getting tangled or chewed doesn't outweigh the possibility of your battery dropping out at just the wrong moment."



Round 4

COOL FACTOR

Most wireless charging solutions are subtle enough that people won't ask you about them until you tell them about them. And, let's face it, you probably will. And they won't care. But your fancy, expensive mouse mat certainly means something to you. Charging your devices constantly and automatically, while not flashy, is damn cool. The freedom of wireless mice has its own intrinsic appeal, and a practical one, too, particularly because they enable you to move away from the desk, and get comfy elsewhere. Design-wise, wireless mice don't tend to differ too much from their wired cousins, at least in terms of shape, but in the world of PC peripherals, 'cool factor' generally has to mean 'covered head to toe in RGB LEDs'. Wired, therefore, takes this category hands down; wireless devices, desperate to maximise battery life, tend to shun pretty lights, although charged mice are likely to get brighter as time goes on. With a wire, there are heaps of gaudy, customisable options, tons more mice with extra buttons and gimmicks, and just much more choice. That sounds pretty cool to us.

WINNER
Wired

Round 5

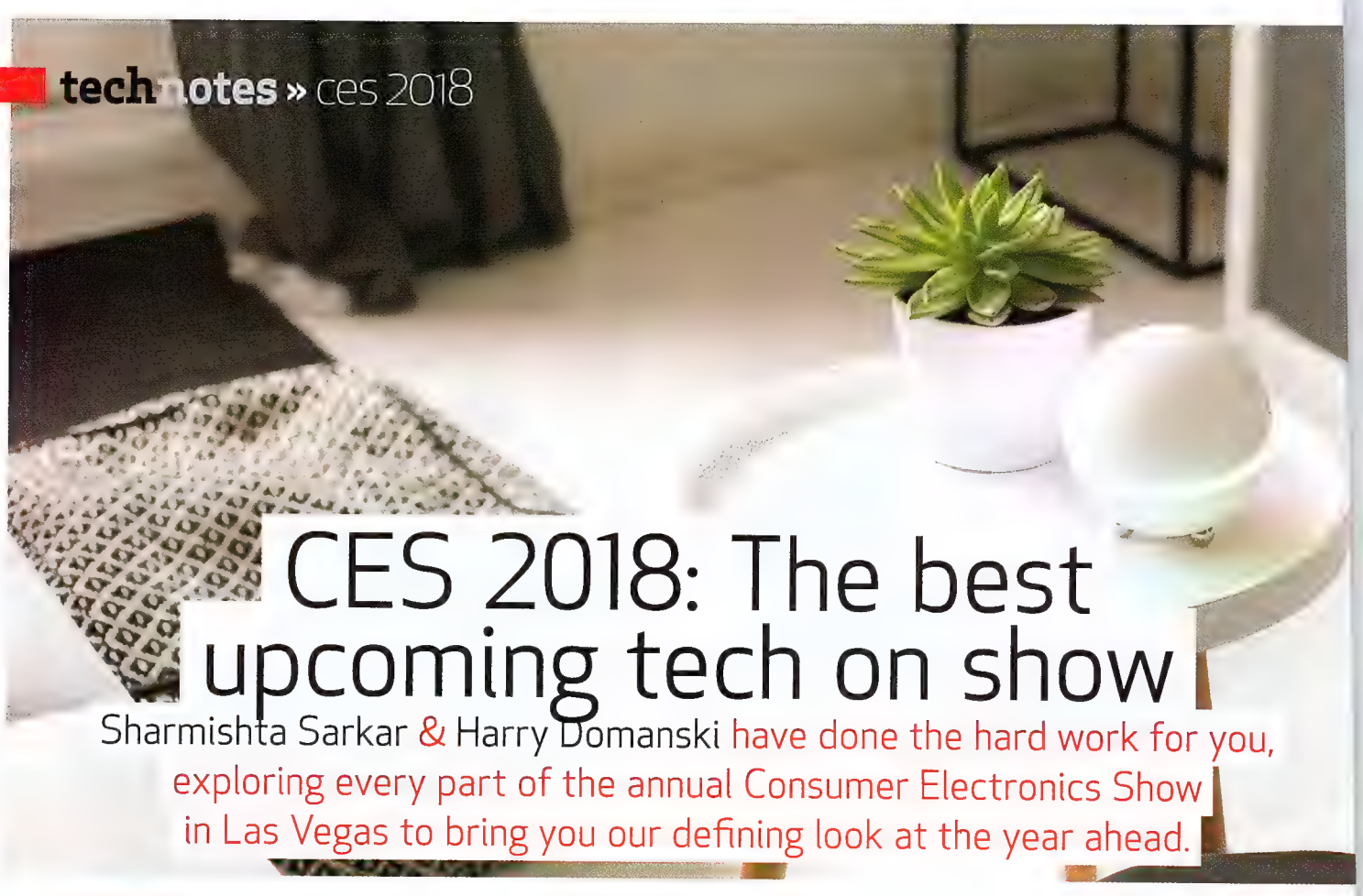
VALUE

Wireless charging, at least right now, is exorbitantly expensive. Far too expensive, if we're being honest, but as the tech matures and its adoption increases, we expect the price will drop down. Whether it will ever dip low enough to win a price comparison contest, though, is highly unlikely, particularly given the affordability of standard wireless and wired mice. Value is another subjective subject — does the usability and flexibility of wireless make its dollar price irrelevant? Should we be looking at the bottom end of the market, where you can pick up a convincing-looking (but probably absolute garbage) 2.4GHz wireless mouse for $10 and change, or a functional wired mouse for a buck? No. That's not what we're about. Looking at quality peripherals highlights a slight premium in the price of wireless mice, particularly where they have wired counterparts sporting much the same tech. You won't have to replace batteries often — depending on your usage and the particular mouse, it could be anywhere from three months to a year — but that's an additional running cost that wired, our winner, just doesn't have.

WINNER
Wired

And the winner is...

Wired mice are the best mice. This result is not simply a case of us being curmudgeonly or pushing some agenda — your mouse, even more than your keyboard, is the most critical input device you have connected to your PC. Precision, speed, accuracy and reliability are paramount. Going wireless means making sacrifices, no matter how small, and the minuscule chance of your cord getting tangled or chewed doesn't outweigh the possibility of your battery dropping out at just the wrong moment, or that critical mouse twitch coming in a half second too late. Wireless mice are much better than they used to be, and picking one up is absolutely not a bad choice, but this is Head to Head, it's a fight, and we have to determine a winner. Wireless charging is an odd fish, because you don't need it, it's too pricey, and there's little practical benefit beyond removing the possibility of your mouse losing juice — but, damn, it's nice to have. We're still fine with wired mice, but a wireless pad (if we're not paying) is a solid second choice. ■



CES 2018: The best upcoming tech on show

Sharmishta Sarkar & Harry Domanski have done the hard work for you, exploring every part of the annual Consumer Electronics Show in Las Vegas to bring you our defining look at the year ahead.

TRENDS

THE BATTLE OF THE VOICE ASSISTANTS

Last year saw Amazon's Alexa take over CES, with the voice assistant integrated into home appliances and cars that were on display at the tech show in 2017. This year, Google Assistant entered the fray – whether it was the first 4K projector with Alexa or an entirely new family of smart display products housing Google Assistant, CES 2018 served as a showcase for voice assistants. Only Siri missed out on the party, though Apple's assistant tends to be more of a lone wolf, anyway. Google and Amazon both recognise that, if they want the voice assistants everywhere, they need to be integrated into everything. And that's exactly what it was like at CES 2018 – from smart home devices to AV products and AR glasses, Alexa and Assistant fought for supremacy.

HOMES WILL GET SMARTER

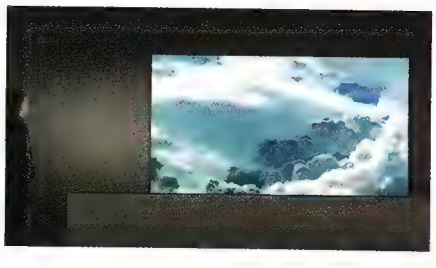
Connected smart home gadgets aren't new. They made an appearance last year at the show, and Google Home has been officially available in Australia for a while now. Some of us might even have smart lights at home. This year, home automation started to become mainstream. Practically every home product on display had a voice assistant integrated. Samsung and GE made connected kitchens seem like a normal home setup, a smart bathroom setup a with voice-controlled shower (which plays music and lights up as well), smart home hubs to keep all your connected gadgets working smoothly, even smart locks – it looks like the homes of the future are just around the corner.

WIRELESS HEADPHONES GO MAINSTREAM

True wireless headphones (ie. earphones that don't have the cable connecting one bud to the other) made an appearance at CES 2017, but with Apple's AirPods becoming popular, headphone manufacturers scrambled to bring out their own versions, many of them catering to fitness fanatics. Considering that most phone makers are ditching the headphone jack, Bluetooth headphones are now a huge part of the consumer market at affordable price points. Companies like Sony, Jabra, JBL and Audio Technica showed off new ranges and, of course, the voice assistants weren't far away. Jabra equipped its new Elite range with Alexa, while Google Assistant partnered with JBL's latest headphones. There were even buds that would help improve your hearing.

MONSTER TVs THAT MOST PEOPLE WON'T BE ABLE TO BUY

At a time when most of us haven't even upgraded our old TV sets to 4K, 8K could seem like a bit of a stretch. But there were gigantic TVs just waiting for plump wallets to stroll in and pick 'em up, at whatever the cost may be – expect five figures, easy. The showstopping 146-inch Samsung TV called The Wall made its debut at CES this year. It's a microLED screen made up of pixels that produce their own light. That means individual pixels can be switch off to customise contrast. LG wasn't about to be overshadowed – the South Korean company not only unveiled its latest range of OLED TVs (including an 88-inch 8K version), but showed off a 65-inch rollable panel. Sony, Hisense and Panasonic also unveiled their new OLED TV ranges catering to the mainstream market.



PCs & LAPTOPS

Razer Project Linda

PRICING AND AVAILABILITY TBC
RAZERZONE.COM/PROJECTLINDA

Project Linda is a concept shown off by Razer that aims to take the portability of 2-in-1s to the next level. The design is of an ultra-portable laptop with a QHD touchscreen that utilises the Razer Phone as its computational core. Once inserted into its slot beneath the keyboard, the phone's display acts as a trackpad (or second screen in some instances) and its speakers become the sound source for the laptop. Linda comes with its own 200GB of storage for extra apps and a powerbank that fast-charges the docked phone.

Lenovo Miix 630

FROM $799 | AVAILABLE Q2 2018
LENOVO.COM/AU

Aiming to give Microsoft's Surface series a run for its money, the Miix 630 from Lenovo is a 2-in-1 powered by Qualcomm's Snapdragon 835 processor and running Windows 10 S. Apart from the usual suspects of a detachable keyboard cover and stylus, the inclusion of a mobile chipset brings the promise of a much slimmer unit that should be able to run much further on a single charge — up to 20 hours apparently — albeit at the expense of some performance when compared to machines powered by desktop processors.

HP Spectre x360 15-inch 2-in-1

FROM US$1,370
AVAILABLE MARCH 18 IN THE US; AU TBC
WWW8.HP.COM/AU

HP hopes to once again enter the ring and face off against the likes of Dell's XPS with the latest update of its 15-inch Spectre x360. This convertible laptop is packing more heat than its last iteration — a quad-core, eighth-gen Intel Core i7 processor, up to 16GB of RAM and a discrete GPU from either Nvidia (GeForce MX 150) or AMD (Radeon RX Vega M) will impress the power-hungry users. However, the overall design has suffered a slight bump in width and weight (around 2mm and 100g) to accommodate.

Lyra Voice from ASUS

PRICING AND AVAILABILITY TBC
ASUS.COM/AU

It was a real challenge to place the Lyra Voice in a category. At its heart, the latest in the Lyra range from ASUS carries the Wi-Fi mesh router torch forward, but with the nifty addition of 8W stereo speakers, built-in Amazon Alexa, and integrated AirProtection network security. With the ability to connect to other Lyra Wi-Fi hubs in order to form a mesh network, the Lyra Voice will make for a powerful control centre for smart homes and music-lovers alike.

GAMING GEAR

Hyperkin Ultra Game Boy

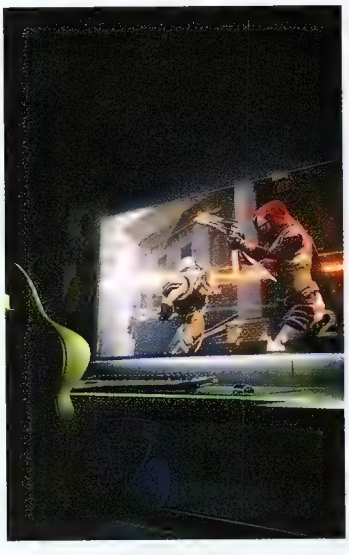
PRICING TBC | AVAILABLE MID 2018
HYPERKIN.COM

The love for retro gaming is alive and well, and the buzz around Hyperkin's Ultra Game Boy proves this, which we expect to sell for less than US$100. This revived bit of kit carries over many of the original's features but with a few additional conveniences. It will be able to play all the classics using the original Nintendo game cartridges, and features the same button layout and form factor of the Game Boy Pocket. However, it features a sturdy aluminium build, a backlit screen for improved visibility, and an in-built, rechargeable battery that will save you from chewing through those AAs.

Nvidia BFGD

PRICING TBC | AVAILABLE LATE 2018
NVIDIA.COM/EN-AU/GEFORCE

While not strictly a singular product, Nvidia has introduced a new specification for what it's calling Big Format Gaming Displays (BFGD), a category that promises to be filled by manufacturers like HP, ASUS and Acer throughout the year. These monitor/TV monstrosities will have a minimum spec of 65-inch displays, 4K resolution, HDR 10, 120Hz refresh rate, full-array LED panel with Quantum Dot Enhancement, G-Sync support and a built-in Nvidia Shield to act as a TV set-top box.

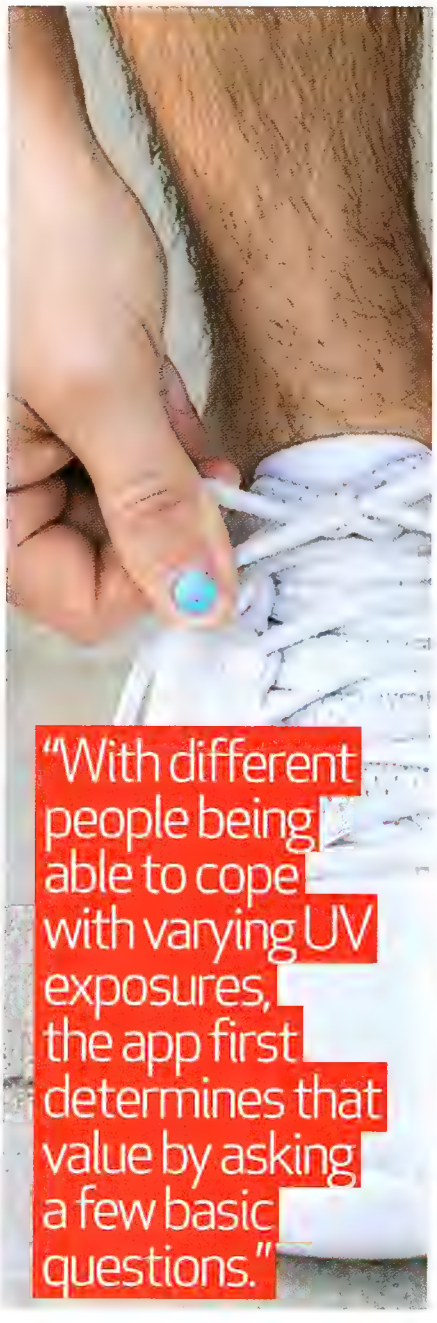


WEARABLES

L'Oreal UV Sense

AVAILABILITY AND PRICING TBC
WWW.LOREAL.COM

L'Oreal could find a ready market in a country like Australia for the UV Sense. Smaller than a fingernail, the UV Sense is a stick-on sensor that tracks how much time its owner has spent in the sun. No Bluetooth or Wi-Fi to be seen here, folks – it's a no-frills NFC-enabled device that pairs with an app. With different people being able to cope with varying UV exposures, the app first determines that value by asking a few basic questions, then provides a score for the time spent in the sun. If you don't want to stick it on yourself, you can pop it onto a bag, watch or sunglasses.


"With different people being able to cope with varying UV exposures, the app first determines that value by asking a few basic questions."

Matrix Powerwatch X

US$249
AVAILABLE EARLY 2018 IN THE US, AU TBC
POWERWATCH.COM

As smartwatches slowly rise in prominence, the manufacturers grow bolder with their innovations. The Powerwatch X is one such product – behind a deceptively simple and rugged smartwatch lies a battery that is able to be recharged from the users own bodyheat. While this concept isn't necessarily new, the optimisation of the latest iteration of the Powerwatch X makes it much more viable as something beyond a gimmick as it's now able to include Bluetooth connectivity, fitness tracking applications and a vibration motor for notifications.

Garmin Forerunner 645 Music

$599 | WWW.GARMIN.COM/EN-AU

Garmin has a reputation for releasing the best sports watches by a country mile. Although it's taken the company a while to launch a sports watch with storage for music, we think the Forerunner 645 Music is shaping up to be the best running watch Garmin has to offer. You can store up to 500 songs on the watch and it should keep you going for up to five days before needing to be recharged via USB. Garmin's advanced tracking features are all packed in as well, and you'll be able to set up Garmin Pay, if your bank supports it.

AUDIO VISUAL

Sony WF-SP700N

US$ 179.99 (AROUND $230)
AVAILABILITY TBC
WWW.SONY.COM.AU

Sony's been trying to cram more and more functionality into smaller form factors and the WF-SP700N sports buds are the company's most feature-packed in-ear headphones yet. With a splashproof IPX4 design and adjustable ANC, this could be one of the more popular true wireless headphones in 2018. The headphones lack fitness tracking elements, but the companion app has seen an upgrade that adds three levels of noise cancellation. More importantly, it adds a 'prioritise stable connection' to stop music from dropping out in areas of high interference.

LG OLED W8 Signature Series

PRICING AND AVAILABILITY TBC
WWW.LG.COM/AU

Physically, LG's 2018 OLED TV screens are similar to the current W7 range; however, the new panels will ship with a 4.2-channel Dolby Atmos soundbar. LG has integrated Google Assistant into the panels, giving users the ability to control TV functions and search for content with their voice. The other noteworthy upgrade is the new Alpha 9 processor that powers advanced clarity and colour processing. It may not seem like a massive improvement over W7 OLEDs, but the W8 definitely has a lot of promise.

JBL Link View

PRICING AND AVAILABILITY TBC
WWW.JBL.COM.AU

JBL's Link View is the first screen-equipped Google Assistant-powered smart speaker to be announced this year. The speaker, with similar functionality to the Amazon Echo Show, looks rather like the JBL Playlist, and features a touch-enabled 8-inch HD display and a 5MP front-facing camera. With the help of Assistant, you get access to Google Photos, YouTube, video calling and everything else a voice-enabled smart speaker can do, including teaching you how to cut a pineapple. What more could you ask for?

VR + AR

HTC Vive Pro

PRICING AND AVAILABILITY TBC
VIVE.COM/AU

If you thought the HTC Vive was impressive, the Vive Pro will just about blow your mind. The dual-OLED displays have been bumped up from 1,080 x 1,200 per eye to 1,400 x 1,600, marking a 78% increase overall, and the addition of integrated headphones makes for a more complete unit. There have been some form alterations as well, such as the inclusion of an adjustable sizing dial on the rear of the unit and some other nuanced changes to improve overall comfort.

Vuzix Blade AR Sunglasses

FROM US$1,000 | AVAILABLE MID 2018
VUZIX.COM

Vuzix Blade is a culmination of Vuzix's 20 years of work in the AR field married with Amazon's Alexa voice assistant, resulting in the first ever smart AR glasses that not only keep you connected but tell you more about the world around you. While they may not be overly comfortable or fashionable at this point, they represent a significant step closer to the reality of functional AR thanks to their built-in voice and touch control.

WEIRD AND WONDERFUL

90Fun Puppy

THE SUITCASE THAT CARRIES ITSELF.

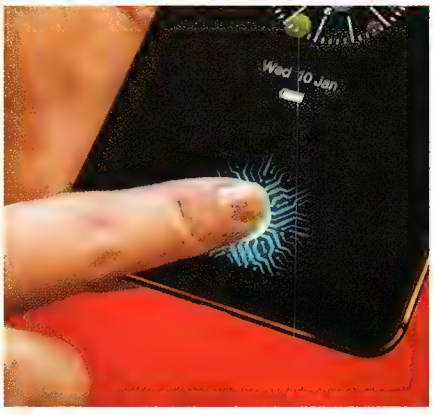
Airlines in the US and Australia have announced a ban on smart luggage pieces due to the risk posed by non-removable Lithium-ion batteries, but that hasn't stopped one company from taking inspiration from the humble Segway. 90Fun's aptly named smart suitcase uses Segway's self-balancing technology to follow you around the airport like, well, a puppy once it's been paired with a remote. While it could be useful to anyone living in constant fear of losing their luggage, they'll have to wait for the final product, as only the prototype — Puppy 1 — was shown off at CES this year.

HiMirror with Alexa

ALEXA, WHO'S THE FAIREST OF THEM ALL?

Talking mirrors are not the realm of fairy tales anymore. Lifestyle brand HiMirror has integrated Alexa to offer skincare and makeup tutorials, track skincare regimes, and suggest and buy cosmetics. HiMirror uses a camera to analyse your skin and complexion, displaying the image on a 10-inch screen. Could be fantastic if you really want to know details on every blemish, wrinkle or flaw on your face. We're also unsure as to who supplies the expert advice that recommends the skincare products.

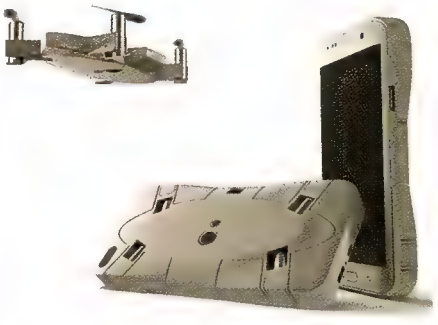
SMARTPHONES AND ACCESSORIES



Vivo smartphone with in-screen fingerprint scanner

AVAILABILITY AND PRICING TBC
WWW.VIVO.COM

A smartphone with an in-screen fingerprint scanner was a hotly rumoured product in December after Synaptics announced the company had figured out how to embed the technology into a screen. But instead of the big names picking up the tech, it was Chinese phone company Vivo that grabbed it, announcing the world's first smartphone with an in-display fingerprint scanner at CES.
The handset itself doesn't break any new design grounds but rival manufacturers won't be far behind, trying to launch their own devices with this groundbreaking tech.



AEE Selfly

US$130 | AVAILABLE Q1 2018
WWW.SELFLY.CAMERA

There were drones aplenty at CES but none as compact as the AEE Selfly – a Transformers-style drone that folds into a phone case. So you not only get to protect your phone but also get to shoot selfies [*Yay... – Ed*], group shots and aerials. The Selfly comes equipped with a 13MP camera and can record 1080p video footage, has a 4-minute flying time and can range up to 45 feet (13.7m). The fold-down drone case can fit most smartphones between the sizes of 4 and 6 inches. ■

MIXED-REALITY HEADSET

$799 | WWW.LENOVO.COM/AU

Lenovo Explorer Mixed Reality Headset

LG offers a fresh look at AR and VR — with some help from Microsoft.

Virtual reality hasn't been the hit many expected. Almost two years after the release of the Vive and Rift, the PC finds itself playing second fiddle to the Sony PlayStation VR.

Into this fragmented landscape, the Lenovo Explorer finds itself as an evolutionary oddity, straddling the moves made by the first-gen headsets and the untethered second-gen models. The hardware spec for the Explorer puts in a good show against those first headsets, supporting a higher native resolution, and the option of augmenting the real with the virtual, but it still relies on a long cable plugged into your graphics card.

The most important aspect for any VR headset is the quality of the image that hits your eyeballs, and here, the Explorer is a mixed bag. The screen door effect that was evident on the first-gen models is still there, but not as obvious, and the added clarity of the higher-res 1,440 x 1,440 displays is welcome. We did have a problem with focus, though, and found getting the image perfect in both eyes almost impossible.

At 380g, the headset is light and comfortable in use, but the foam cushioning around the visor introduces subtle movements when you move your head, causing blurring. The immersion isn't ideal either, because the screens are small, which gives a general feeling that you're experiencing these virtual worlds through a diving mask, rather than actually being in the world.

The Explorer lacks audio playback, preferring to let the user use their own headphones of choice, which is fine in theory, but in practice, it means there are even more wires and clutter. The fact that the Vive Pro integrates audio into the headset is a good sign of where things need to go.

You're going to need a relatively kick-ass machine to get the most from this headset — it shouldn't come as too much of a surprise to learn that you'll need a modern graphics card, although the reliance on Bluetooth 4.0 indicates that this is a platform that is aimed at laptop users more than high-end desktops.

The controllers work well, and feel good in hand, and while, initially, knowing where the various buttons and thumbsticks are is a little tricky, a couple of hours in, it's all very natural. The Explorer supports room-scale VR without relying on Lighthouses, too, and from our experience, it works well.

There is a potentially bigger problem for Lenovo, though — there's still no killer app, a convincing reason to buy into VR. Windows Mixed Reality does scatter a few more apps into the mix, but there's nothing meaty enough to have us recommending you rush out and buy one. There's also the nagging feeling that maybe, just maybe, traditional gaming isn't the best use of VR's capabilities.

The fact that the Lenovo Explorer is available for $800 is to be commended. However, the market needs to move on even faster, and while a positive step, we expect even more to get the PC back on top of the VR game. ■ **Alan Dexter**

Verdict

Features	★★★½☆
Performance	★★★½☆
Value	★★★★☆

With high resolution displays in a comfortable headset and at a good price, it's good, but why get one?

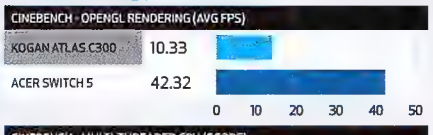
★★★½☆

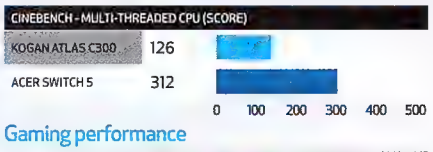
$499 | WWW.KOGAN.COM/AU

LABS BENCHMARK RESULTS

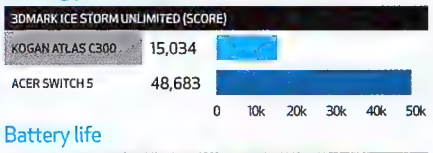
General performance

Media encoding performance

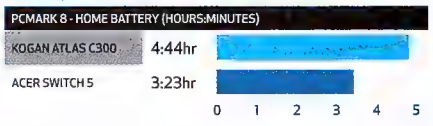




Gaming performance



Battery life



Kogan Atlas C300 Convertible Notebook

Can this super-cheap 2-in-1 really compete with more expensive alternatives?

This $500 2-in-1 from budget Aussie retailer Kogan really is better than it has any right to be. With a unibody metal chassis, it both looks and feels incredibly sturdy and durable, and its 13.3-inch IPS display is better than what you often find on laptops for two (or even three) times this price.

Don't get us wrong, though: this is not a powerhouse that's going to take down the likes of say, Dell's XPS 13 – a device that's still our favourite Windows ultrabook, despite the general design being a few years old now. In fact, compared to that Dell, what's under the C300's hood looks rather sedate. Primarily powered by a quad-core 1.1-2.2GHz Intel Celeron N3450 processor – a chip that's about a year and a half old at this point – in combination with a very basic Intel HD Graphics 500 GPU and 4GB of RAM, you won't be doing any seriously-demanding tasks. You can forget about video encoding or high-end image editing, and anything but games with simple 2D graphics or retro titles will be possible here.

The storage on offer is adequate – 64GB of flash in the form of a SanDisk DF4064. That's an embedded MMC (eMMC) drive, rather than an SSD. The eMMC format was born out of a desire to use cheaper flash storage on computing devices like tablets and netbooks – what you're basically getting is an SD card soldered onto the motherboard. That's not quite as dire as it sounds, however, because here, the flash storage does at least outperform a magnetic hard drive in most tasks, with sustained read and write speeds of 177MB/s and 102MB/s, respectively.

What's more difficult to deal with is the lack of space that 64GB results in. Disk formatting shenanigans and the considerable size of Windows itself consume about half the drive, leaving you with slightly under 30GB to use for your own apps and files. Thanks to a built-in slot, you can add in a microSD card to supplement that, but a better option would be to grab an M.2 SSD to install – the addition of a 128 or 256GB SSD would transform this into a a much more well-rounded machine, but you will need to install that drive yourself, as Kogan sadly doesn't offer it as an pre-configured option.

The included charger is also a bit anaemic – it's the kind of plug adapter you'd expect to come bundled with a cheap clock-radio, not a 13-inch laptop, and at 1.10m the cable is a fair bit shorter than we'd like.

On the upside, the combo of basic components in the C300 is at least good enough for any day-to-day task you can think of, from surfing the web to streaming videos on Netflix to creating and editing Word docs or spreadsheets. It works reasonably well as a tablet thanks to that fold-around screen (the hinges are surprisingly sturdy) and the keyboard and trackpad are comfortable and large. There's even two full-sized USB 3.0 ports, a mini-HDMI output and a metal stylus included, too, and the battery lasts a good 4–6 hours, depending on the task.

In other words, if your needs are relatively undemanding, this one punches well above its weight. ■ **Dan Gardiner**

Verdict

Features	★★★★☆
Performance	★★★☆☆
Value	★★★★★

It's a sports-car on the outside and a lawnmower under the hood, but the C300 will still get you from A to B.

★★★★☆

GAMING LAPTOP

FROM $3,399.95 | WWW.RAZERZONE.COM

Razer Blade Pro (2017)

Does the concept of a 'thin-and-light' 17-inch gaming laptop actually have legs?

Razer is basically attempting the impossible with its latest revamp of the Blade Pro, matching a 17.3-inch screen with a thin (well, 'thinner') form factor than you typically see in gaming laptops of this size. The result is admittedly still a beastly and burly machine, but it's one that's been made about as svelte as you could reasonably ask, and weighs a respectable 3.07kg sans power brick.

Like Razer's other Blades, the overarching design is rather MackBook-like, with nice clean lines and a tough metal exterior that looks very much like a black version of Apple's circa-2012 MacBooks – and, physically, the Blade Pro is the closest thing we've seen to a 17-inch MacBook since Apple discontinued the latter way back in 2012.

The entry-level model of the Pro we tested for this review packs a GeForce GTX 1060 GPU, which is powerful enough to drive the unit's 1080p IPS G-Sync display along at a reasonable clip, although not quite to its full 'gaming' 120Hz refresh rate... or at least, not in the latest, most-demanding games. You can also optionally step up to a GTX 1080/4K display model, which starts at an eye-watering $5,899.95 for the 512GB option and climbs even higher for the 1TB and 2TB units.

The specs are adequate-to-mixed elsewhere on this entry level unit. While it's only using a 7th-gen Intel CPU (despite the 8th-gen equivalents having been available for a couple of months), but it's the near top-of-the-tree Core i7-7700HQ, and there's a useful 16GB of DDR4-2400 memory to accompany that.

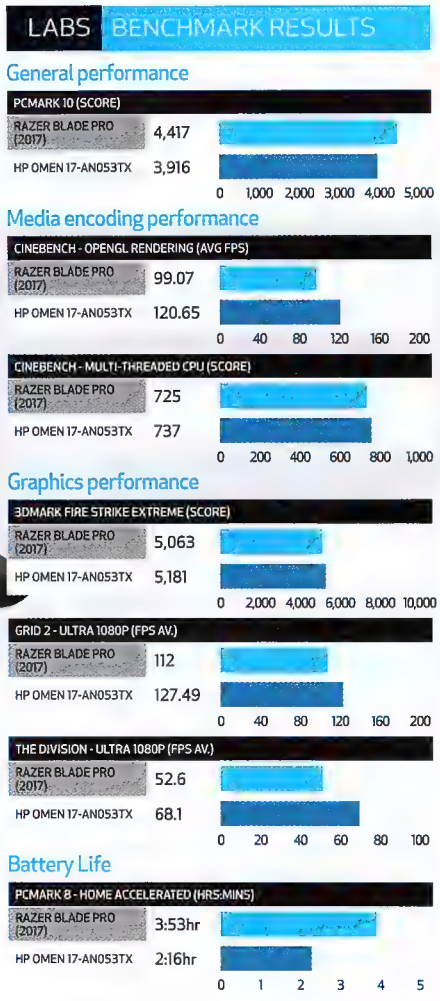
The bigger chassis size has let Razer squeeze in some useful extras elsewhere, too, including an RJ-45 Gigabit Ethernet port and a full-sized HDMI output, alongside an SDXC card reader, three USB-A 3.0 ports and one USB-C/Thunderbolt 3 port. You also get a combination of 256GB SSD and 2TB 5,400rpm mechanical hard drive for storage.

The extra space provided by the 17-inch chassis has let Razer's designers make some interesting choices when it comes to inputs, too, like the decision to squeeze the Pro's large trackpad in to the right of the keyboard. For left-handers, that'll likely make the Blade Pro uncomfortable to use without a mouse, although for right-handed use, we had no problems.

Also neat is that, because, it's only using a relatively undemanding GTX 1060, this particular Blade Pro comes with a quite-compact power brick that weighs just 550g – a fair drop down from the 1kg+ models bundled with most larger gaming laptops. Be warned, however, that the GTX 1080 models will come with a larger charger to accomodate that GPU's higher power requirements.

This more budget-oriented Blade Pro, then, is a fairly interesting proposition. It's got enough power to game on at 1080p, and for a 17.3-inch G-Sync laptop, its price is quite reasonable. On the other hand, at nearly six grand (or more), we can't quite say the same of its 4K siblings...

Dan Gardiner


LABS BENCHMARK RESULTS
General performance
PCMARK 10 (SCORE)
RAZER BLADE PRO (2017) 4,417
HP OMEN 17-AN053TX 3,916
0 1,000 2,000 3,000 4,000 5,000
Media encoding performance
CINEBENCH - OPENGL RENDERING (AVG FPS)
RAZER BLADE PRO (2017) 99.07
HP OMEN 17-AN053TX 120.65
0 40 80 120 160 200
CINEBENCH - MULTI-THREADED CPU (SCORE)
RAZER BLADE PRO (2017) 725
HP OMEN 17-AN053TX 737
0 200 400 600 800 1,000
Graphics performance
3DMARK FIRE STRIKE EXTREME (SCORE)
RAZER BLADE PRO (2017) 5,063
HP OMEN 17-AN053TX 5,181
0 2,000 4,000 6,000 8,000 10,000
GRID 2 - ULTRA 1080P (FPS AV.)
RAZER BLADE PRO (2017) 112
HP OMEN 17-AN053TX 127.49
0 40 80 120 160 200
THE DIVISION - ULTRA 1080P (FPS AV.)
RAZER BLADE PRO (2017) 52.6
HP OMEN 17-AN053TX 68.1
0 20 40 60 80 100
Battery Life
PCMARK 8 - HOME ACCELERATED (HRS:MINS)
RAZER BLADE PRO (2017) 3:53hr
HP OMEN 17-AN053TX 2:16hr
0 1 2 3 4 5

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★½

A sleek and well-built 17-incher that offers enough power to get the job done and comes at a surprisingly fair price.

★★★★½

13-INCH ULTRABOOK

FROM $2,199 | WWW.RAZERZONE.COM

Razer Blade Stealth (2017)

A higher class of ultrabook.

The Razer Blade Stealth is one of our favourite ultrabooks, and it's only getting better with age. This version sports Intel's latest, 8th-gen Kaby Lake Refresh processors, helping it deliver its best ever performance.

Starting at around $2,199, it's more expensive than ever, partially thanks to its elevated specs. Each of the models in the range rocks a quad-core Intel Core i7 processor with integrated Intel UHD graphics, a QHD+ (3,200 x 1,800) resolution display, 16GB of RAM and a 256GB SSD. Our model also allows you to double your storage capacity.

Despite the increase in screen size, the 13.3-inch Stealth is no larger than its 12.5-inch predecessor, maintaining most of its original dimensions at 32.1 x 20.6 x 1.4cm. The Kaby Lake Refresh update also bumps up the weight from 1.33kg to 1.35kg – likely due to the additional cooling needed for the new CPUs.

Aside from the bezels, the biggest aesthetic change is the new gunmetal finish. Synonymous with its name, the Stealth has always been Razer's most understated laptop. The new colour adds to that quality. Gone too are the RGB keyboard and light-up lid logo, replaced with a simpler white backlight. The result is a professional-looking Razer ultrabook design, with its off-grey paint job setting itself apart from the pack. If you'd rather have RGB lighting and a jet-black look, the regular version of the Stealth is also available.

It comes with powerful speakers and a large, tactile keyboard. Razer has also upgraded its ultrabook with a Windows Precision Touchpad. We didn't have many complaints with the trackpads on previous models, but the direct-from-Microsoft drivers offer even better tracking and multi-touch gesture recognition.

It's remarkable that Razer has squeezed in a bigger display without making the laptop any larger. It's done this by reducing the bezels on all sides by 50%. It also features a sharper 3,200 x 1,800-resolution panel. Unfortunately, there's no option of getting a 4K display on this ultrabook. But to our eye, the QHD+ screen here resolves plenty of detail as is, and we don't really miss having an Ultra HD res on a screen this small. The new display also boasts 100% sRGB colour coverage and up to 400 nits of brightness. The screen is much brighter now.

Quad-core Kaby Lake Refresh processors have helped the Stealth make a huge leap in performance. While it's a given that more cores usually lead to better performance, its benchmark numbers are impressive. For starters, the 8th-gen Intel CPUs deliver a more than 75% increase in multi-core performance compared to 7th-gen Kaby Lake. This leads to correspondingly higher scores in Cinebench and PCMark 8.

You can fire up *Overwatch* for a smooth gaming experience with high fps, but you'll still be relegated to awfully low settings. And that pretty much goes for most games you try to play on this ultrabook.

The battery life has taken a hit, however. The Stealth ran our movie test at 5 hours and 9 minutes, shorter than the previous model. This is due to the larger, sharper screen and the new quad-core processor.

The Stealth has matured into the ultrabook we always wanted. Aside from its battery life, it's on a par with other similarly-specced ultrabooks. ■

Verdict

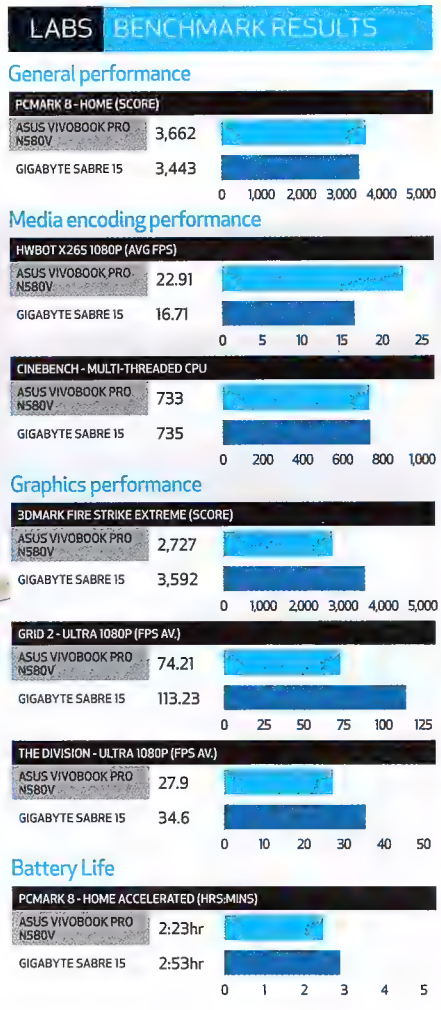
Features	★★★★½
Performance	★★★★
Value	★★★★½

With its vibrant display and excellent performance, this is an ultrabook for everyone.

★★★★½

LAPTOP

FROM $1,499 | WWW.ASUS.COM/AU


LABS BENCHMARK RESULTS
General performance
PCMARK 8 - HOME (SCORE)
ASUS VIVOBOOK PRO N580V 3,662
GIGABYTE SABRE 15 3,443
0 1,000 2,000 3,000 4,000 5,000
Media encoding performance
HWBOT X265 1080P (AVG FPS)
ASUS VIVOBOOK PRO N580V 22.91
GIGABYTE SABRE 15 16.71
0 5 10 15 20 25
CINEBENCH - MULTI-THREADED CPU
ASUS VIVOBOOK PRO N580V 733
GIGABYTE SABRE 15 735
0 200 400 600 800 1,000
Graphics performance
3DMARK FIRE STRIKE EXTREME (SCORE)
ASUS VIVOBOOK PRO N580V 2,727
GIGABYTE SABRE 15 3,592
0 1,000 2,000 3,000 4,000 5,000
GRID 2 - ULTRA 1080P (FPS AV.)
ASUS VIVOBOOK PRO N580V 74.21
GIGABYTE SABRE 15 113.23
0 25 50 75 100 125
THE DIVISION - ULTRA 1080P (FPS AV.)
ASUS VIVOBOOK PRO N580V 27.9
GIGABYTE SABRE 15 34.6
0 10 20 30 40 50
Battery Life
PCMARK 8 - HOME ACCELERATED (HRS:MINS)
ASUS VIVOBOOK PRO N580V 2:23hr
GIGABYTE SABRE 15 2:53hr
0 1 2 3 4 5

ASUS VivoBook Pro N580VD-DM264T

Business on the outside, gaming on the inside.

ASUS's new VivoBook Pro has managed to dodge the price-up/performance-down rut that many of its aluminium-clad counterparts get stuck in. Impressively, this sleek machine actually runs as fast (and hot) as some gaming systems.

The VivoBook Pro sports a very familiar MacBook-esque aesthetic combining a brushed aluminium shell with premium and well-spaced keys and sensibly stylish curves. With substantial bezels, a 19mm thick chassis and a weight just shy of 2kg, this 15.6-inch unit doesn't follow in the footsteps of the slim-and-compact ultrabooks that currently rule the roost, but the bonus room allows it to pack in some surprising power and shave off some dollars instead. Most notably, the inclusion of an Nvidia GeForce GTX 1050 (4GB VRAM) GPU and a quad-core Intel Core i7-7700HQ processor puts it on par with gaming laptops that typically run closer to $2,000. When compared to ASUS's own RoG Strix GL553VE gaming laptop ($1,999), the VivoBook Pro was only marginally bested in every gaming benchmark we ran. We were also impressed by the relatively inoffensive level of fan-noise during gaming, and while the internal temperatures reached a toasty 96°C and 80°C (for the CPU and GPU, respectively), the shell never grew uncomfortably hot.

The biggest trade off with the VivoBook Pro is that the battery life is a little disappointing, enduring less than three hours of media playback at 50% screen brightness and beaten out in PCMark 8's battery tests by units with more power-hungry GPUs. The model we tested (N580VD-DM264T) comes with a 1TB HDD, which didn't quite read or write at anticipated speeds, and 8GB of DDR4 RAM. This more price-conscious config's main shortcoming is its TN display, however. The colours are a little flat and the viewing angles are also a tad limited. Despite that, the 1080p screen is still serviceable for gaming, everyday use and media consumption, and the Harman Kardon-designed speakers are about as good as you'll get on a laptop. If that TN screen's not good enough for you, an extra $450 or so can get you the next model up (N580VD-FI263T) which boasts a 4K IPS panel, an additional 256GB SSD and 16GB RAM, although those upgrades will likely negatively affect battery-life, as both models share the same capacity.

The spec-bump on offer from the higher model does not translate favourably to gaming, sadly. Running the latest titles at 4K will prove too taxing on that GTX 1050 GPU and the SSD won't do much beyond decreasing load times.

That said, the fact that the VivoBook Pro performs well with low-level gaming is a rather impressive cherry on the top of an otherwise exceptionally competent productivity-focused cake, and anyone looking for a day-to-day machine to occasionally game on will enjoy this feast, as long as you don't stray too far from a powerpoint.

Harry Domanski

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★★

For casual gamers and media-lovers, that enticing price makes this one hard to look past.

★★★★½

2-IN-1

FROM $1,899 | WWW.LENOVO.COM/AU

Lenovo Yoga 920

Another remarkable hybrid laptop from Lenovo.

The Lenovo Yoga 920 features USB-C ports, an improved webcam location, a better keyboard and boosted battery life, while retaining the 360-degree hinge that's a hallmark of the Yoga range. However, with devices such as the Microsoft Surface Book 2 pushing the boundaries of what we should expect from 2-in-1s, the Yoga 920 has its work cut out if it's to really stand out.

The base model Yoga 920 comes with an Intel Core i5-8250U processor, a 256GB SSD, 8GB of RAM, a 13.9-inch 1080p touchscreen and an Active Pen stylus. The second model – which we're testing here – comes with the same specs as above, but features a faster Intel Core i7-8550U processor and a larger 512GB SDD.

The 920 is thin, yet sturdy, weighing in at 1.37kg and measuring 32.3 x 22.3 x 1.4cm. This means it has a nice heft, without feeling heavy or bulky. It also has a metallic finish which adds to the premium feel, although it quickly becomes a haven for fingerprints.

The hinges along the back are eye-catching – we've fluctuated between thinking they're stylish and finding them a bit gaudy. There's no doubting the strength and build quality of the hinges, though. Like the hinge on the Surface Book 2, they're strong enough to angle the screen without the body tipping up, while the screen remains held in place. Unlike the Surface Book 2, however, the design of the hinges doesn't stick out quite as much, and the screen can flip a full 180-degrees. Plus, the keyboard is clever enough to turn off, so the keys don't interfere when in tablet mode.

There aren't many connectivity options; there's a headphone/mic jack and two USB-C ports – one of which is also used as the power supply – and a full-size USB 3.0 port. The number of ports isn't too restrictive here, and is a reasonable trade-off for the svelte design.

One thing we criticised the Surface Book 2 for was the fact that you'll need to pay extra for the Surface Pen stylus. Thankfully, the Yoga 920 comes with a battery-powered Active Pen as part of the package. It has a nice design and the Yoga responds well to it, thanks to its screen being able to detect 4,096 levels of pressure. Light presses and hard presses are registered accurately, and it can keep up with even the most frantic scribbles. The keyboard is large enough to type comfortably on, and despite the keys being fairly shallow, they have satisfying travel.

The config we tested is impressive, performance-wise. Day-to-day tasks are usually processed quickly, although it took the Yoga quite a long time to extract a large ZIP file, which also caused its fans to kick in. The touchscreen is also fast and responsive, while the 1080p screen looks fantastic with crisp and bright visuals and deep, dark blacks. Sound quality is good, too.

For any graphically-strenuous tasks or modern gaming, however, you may not want to settle for the limited integrated graphics on offer here.

The Yoga lasted 9 hours 23 minutes in our movie test and just over 4 hours in the PCMark 8 Battery Life benchmark, which simulates medium to high usage. The Yoga does recharge very quickly via USB-C, though – taking just 90 minutes to reach 92%.

In all, it's a triumph. Just don't expect to do much gaming or rendering on it. ■

Verdict

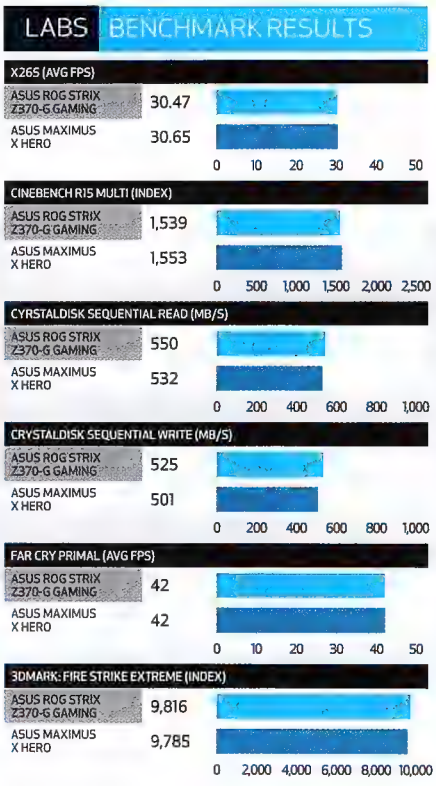
Features	★★★★½
Performance	★★★★½
Value	★★★★

The Yoga 920 is a premium 2-in-1 with performance to match – only its integrated graphics let it down.

★★★★½

INTEL MOTHERBOARD

$289 | WWW.ASUS.COM/AU


LABS BENCHMARK RESULTS
X265 (AVG FPS)
ASUS ROG STRIX Z370-G GAMING 30.47
ASUS MAXIMUS X HERO 30.65
0 10 20 30 40 50
CINEBENCH R15 MULTI (INDEX)
ASUS ROG STRIX Z370-G GAMING 1,539
ASUS MAXIMUS X HERO 1,553
0 500 1,000 1,500 2,000 2,500
CYRSTALDISK SEQUENTIAL READ (MB/S)
ASUS ROG STRIX Z370-G GAMING 550
ASUS MAXIMUS X HERO 532
0 200 400 600 800 1,000
CRYSTALDISK SEQUENTIAL WRITE (MB/S)
ASUS ROG STRIX Z370-G GAMING 525
ASUS MAXIMUS X HERO 501
0 200 400 600 800 1,000
FAR CRY PRIMAL (AVG FPS)
ASUS ROG STRIX Z370-G GAMING 42
ASUS MAXIMUS X HERO 42
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3DMARK: FIRE STRIKE EXTREME (INDEX)
ASUS ROG STRIX Z370-G GAMING 9,816
ASUS MAXIMUS X HERO 9,785
0 2,000 4,000 6,000 8,000 10,000

ASUS RoG Strix Z370-G Gaming

Number one of three.

Motherboards like this don't come around often. Perhaps it's due to Coffee Lake's minuscule power requirements, or maybe because Intel's mature platform needs little iteration between generations, but the micro-ATX form factor doesn't seem to get much love from mobo designers. Which is a shame, because it's a perfect combination of form and function.

Just take a look at the arsenal attached to this 9.6-inch square of PCB joy: two M.2 PCIe SSDs, six SATA 6Gbps ports, dual PCIe x16 slots, USB 3.0 header, five PWM fan headers, and support for 64GB of DDR4 running all the way up to 4,000MT/s. Pretty snazzy. It's not a huge amount, but it's more than enough to forge any number of RAID arrays, run SLI and Crossfire configs, and pump a decent amount of airflow around all at the same time.

It's a beautiful thing to be so perfectly balanced, and the industry seems to have forgotten just how important such balance is. It's ironic, really, when you consider how much we've moved away from pure performance, and leaned more toward power savings to try to balance our semiconductors more.

That aside, ASUS's RoG Strix Z370-G motherboard is a solid choice on more than just form factor and function. The bare-bones brushed steel look, littered with stripes across the board, looks crisp and sharp. What limited RGB lighting there is, is confined entirely to the logo on the chipset. There's no rear I/O cover, no audio cover, no armour. It's nice and simple, and sophisticated because of it. It's one of the main reasons we chose this board for last issue's PC Builder feature.

Nowadays, building a themed black-and-white system is no easy feat, especially given the level of RGB and lighting baked into almost everything. So the subtle lines and colour of components really made this board stand out against the other options currently available. Admittedly, we didn't have a whole lot of choice – a meager three micro-ATX form factor mobos sit in the Z370 space right now, so it was hardly a tough call, but still...

As far as performance is concerned, the Z370-G falls exactly where you would expect it to. Power draw is quite high in contrast to the competition, along with clocks edging up ever so slightly because of it. That's not so great when it comes to temperatures, but it is good for stock performance.

In Cinebench, we saw figures hit the 1,539 mark, and X265 hit 30.47fps, compared to MSI's Z370 Godlike Gaming which managed 1,422 and 28.32 respectively, albeit at far lower temps than ASUS's power-hungry offering. That aside, there's little to report – performance is exactly what you'd expect.

Ultimately, then, if you're after a micro-ATX 'board on the Z370 platform, the Z370-G is likely your best bet. Its smooth, clean style, solid performance, and intuitive BIOS make it a standout choice, and the best of three in a world of slim pickings.

Zak Storey

Verdict

Features	★★★★
Performance	★★★★½
Value	★★★★

While in a niche corner of the market at the moment, that doesn't detract from its attractiveness.

★★★★½

WHAT'S THE NEXT

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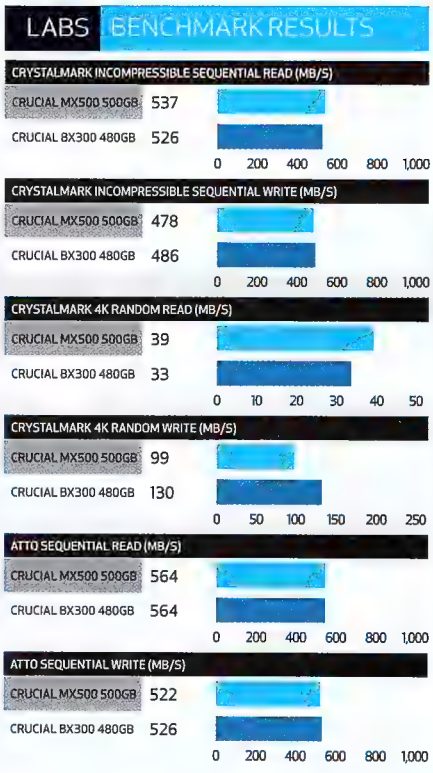
LABS BENCHMARK RESULTS
CRYSTALMARK INCOMPRESSIBLE SEQUENTIAL READ (MB/S)
CRUCIAL MX500 500GB 537
CRUCIAL BX300 480GB 526
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CRYSTALMARK INCOMPRESSIBLE SEQUENTIAL WRITE (MB/S)
CRUCIAL MX500 500GB 478
CRUCIAL BX300 480GB 486
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CRYSTALMARK 4K RANDOM READ (MB/S)
CRUCIAL MX500 500GB 39
CRUCIAL BX300 480GB 33
0 10 20 30 40 50
CRYSTALMARK 4K RANDOM WRITE (MB/S)
CRUCIAL MX500 500GB 99
CRUCIAL BX300 480GB 130
0 50 100 150 200 250
ATTO SEQUENTIAL READ (MB/S)
CRUCIAL MX500 500GB 564
CRUCIAL BX300 480GB 564
0 200 400 600 800 1,000
ATTO SEQUENTIAL WRITE (MB/S)
CRUCIAL MX500 500GB 522
CRUCIAL BX300 480GB 526
0 200 400 600 800 1,000

Crucial MX500

Are you SATA-isfied with this legacy interface?

The march of technology waits for no man. Unless the poor sap in question relies upon the SATA interface for his PC storage connectivity. In which case, technology is apparently happy to sit down and soak up the view.

That's because of the limitations associated with SATA. First, there's a hard bandwidth limit of around 550MB/s, net of overheads. Then there's the fact that SATA is reliant on the AHCI control protocol, which hails from the mists of 2004, making it positively antediluvian in tech terms. Critically, it also means that AHCI was never conceived with solid-state storage in mind. It was designed to suit magnetic drives and read heads, not NAND chips.

One of the more obvious upshots is the practical cap it puts on random access performance. AHCI isn't optimised to allow SSDs to give their best when it comes to random access performance. With that long-winded preamble in mind, may we present Crucial's newest SSD – the MX500.

It's a plain old SATA drive, so all of the above limitations apply. Not that this should be a huge surprise, given Crucial is yet to launch a PCI Express-based drive for consumers that supports the more modern NVMe control protocol. That, in turn, reflects the fact that the market for add-in drives such as this remains dominated by SATA, regardless of its limitations.

The MX500 does bring some substantial hardware changes to Crucial's flagship line of SSDs, though. It gets parent company Micron's new 64-layer 3D TLC NAND memory. Just as important is the switch from Marvell to Silicon Motion for the controller chipset. That said, the raw specifications are little changed over the previous MX300 drive – and, indeed, the MX200 before that.

The exceptions include a much improved 350TB data endurance rating, and an upping of the warranty from 3 to 5 years. It's the latter that marks out the MX500 as a drive that can trade blows with premium SATA offerings.

For the record, the Crucial MX500 delivers solid, if predictable, numbers in the bulk of our benchmarks. Peak reads rock in at 564MB/s, writes at 522MB/s. Random reads of 39MB/s are decent for a SATA drive, ditto the 99MB/s for random writes, even if the latter is a little slower than Crucial's own BX300 budget drive. You can say the same for the 147 seconds it racks up on our internal file copy test.

In reality, most of those numbers are fairly academic, in that they're free from obvious flaws. The same goes for our subjective experience with the drive shunting data around. It doesn't suffer from any obvious glitches or the infuriating cache-related slowdowns that some drives exhibit. That's true despite the fact that the MX500 has an SLC write caching mode, designed to accelerate bursty workloads – we didn't find a usage scenario where we could detect its limitations.

If the new MX500, therefore, establishes itself as a solid all-around SATA SSD, the final test involves bang for buck. As we go to press, this 1TB iteration can be had for just $390. That's seriously competitive for a drive with such solid performance and a 5-year warranty.

■ Jeremy Laird & Joel Burgess

Verdict

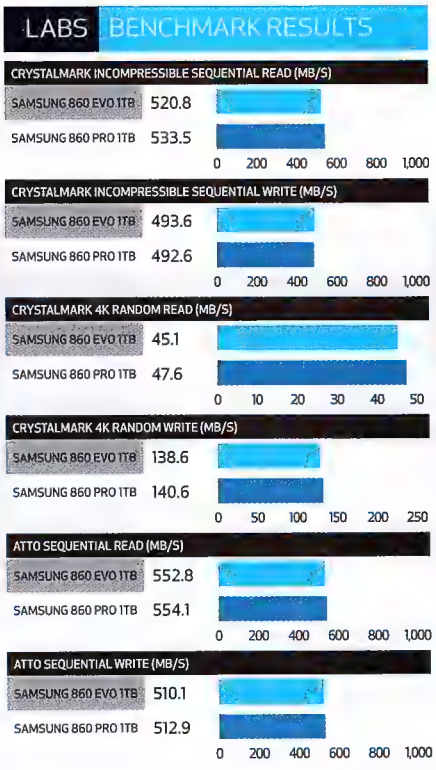
Features ★★★★½
Performance ★★★★½
Value ★★★★★

Better endurance, a 5-year warranty and a new chipset put this 2.5-inch SSD just ahead of the competition.

★★★★½

SSD

860 EVO FROM $140 (250GB); 860 PRO FROM $200 (256GB) | WWW.SAMSUNG.COM/AU


LABS BENCHMARK RESULTS
CRYSTALMARK INCOMPRESSIBLE SEQUENTIAL READ (MB/S)
SAMSUNG 860 EVO 1TB 520.8
SAMSUNG 860 PRO 1TB 533.5
0 200 400 600 800 1,000
CRYSTALMARK INCOMPRESSIBLE SEQUENTIAL WRITE (MB/S)
SAMSUNG 860 EVO 1TB 493.6
SAMSUNG 860 PRO 1TB 492.6
0 200 400 600 800 1,000
CRYSTALMARK 4K RANDOM READ (MB/S)
SAMSUNG 860 EVO 1TB 45.1
SAMSUNG 860 PRO 1TB 47.6
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SAMSUNG 860 PRO 1TB 512.9
0 200 400 600 800 1,000

Samsung 860 EVO & 860 Pro

The king of consumer SSDs finally updates its most-popular drives.

Much like the Crucial MX line on the previous page, Samsung's SATA-based SSDs basically maxed-out the SATA interface a few generations ago – and, in fact, it's been over 3.5 years since Samsung's last major refresh of this mainstream line: the Korean company releasing the 850 Pro and EVO way back in 2014. It hasn't updated the line because it hasn't needed to – despite its age, the 850 EVO continues to be the top-selling consumer SSD family in the global market.

These new drives are a by-the-books upgrade that follows much the same Samsung formula as before – the company makes every major component, from the 64-layer V-NAND flash (up from 32-layer) to the new MJX controller (superseding the previous-gen's MHX) to the DDR4 memory used for caching. In their 2.5mm versions (they're also available in M.2), both have slimmed down slightly and are now 7mm drives.

The main difference between the EVO and Pro lines is the type of NAND flash they use – which are TLC and MLC, respectively. MLC stores two (aka 'multiple') bits in every cell vs TLC's three ('triple') bit structure – the more bits you cram into one cell, the cheaper it is to manufacture and the larger you can make the drives. And while that doesn't change much when it comes to performance (that SATA interface is still the real bottleneck there, and Samsung has only increased the sustained read and write speeds by 10MB/s each), it does make a difference to endurance. Because it uses two-bit MLC flash chips, the Pro has always offered better endurance ratings and, in its 850 iteration, a 10-year warranty. Samsung has seemingly reconsidered the latter and has dropped the warranty on the 860 Pro to match the EVO: both are now 5 years. Regardless, both lines have got a big jump in their claimed endurance, which, for the 2TB EVO and Pro models, is 1,200TB and 2,400TB written over their lifetimes, respectively. That's a four-fold increase over the 850s, and significantly higher than the 2TB MX500's 700TBW.

The thing is that consumer workloads don't really stress an SSD enough to require that kind of read/write level – it's only enterprise-class data centre applications where the Pro family's extra endurance starts to make financial sense.

New drives do, of course, generally mean a higher price and that's really the 860 series' main shortcoming. Per gigabyte, they're not nearly as price competitive as Crucial's MX500s or, indeed, the 850 EVO and Pro lines – of which there still seem to be plenty in the market. You can pick up a 1TB 850 EVO for $390 vs the 860 EVO's $480, and unless you're doing super-intensive read and writing of data, the former should last out until its time for an upgrade... by which time, we'll presumably have 870 EVOs and Pros to play with.

Dan Gardiner

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★½

The endurance increase is nice, but the price hike arguably just makes the 850s even more attractive.

★★★★½

4K MONITOR

$1,299 | WWW.VIEWSONIC.COM.AU

ViewSonic VP3268-4K

Is this the ideal affordable almost-pro panel?

Desktop PCs get a raw deal when it comes to pixel count. After all, fairly affordable laptop PCs with full 4K panels are now widely available. Heck, 1440p is no longer anything special for a smartphone.

4K is about as good as it gets on the desktop, despite the much larger physical size of desktop panels. At least, it is unless you're willing to spend megabucks. The net result is that desktop monitors can't hold a candle to the best portable devices when it comes to pixel density, and thus display crispness and detail. The mitigating factor, of course, is that Windows, and indeed the internet at large, still doesn't do a great job of supporting high DPI displays.

That's part of the context for ViewSonic's 32-inch VP3268-4K. It threads the needle between smaller 4K panels (that throw up issues in Windows when running the scaling above 100% in order to maintain legibility) and larger 40-inch-plus 4K panels (that remain legible at 100% scaling, but suffer from relatively fat, ugly pixels); 32 inches at 4K is something of a sweet spot.

The VP3268-4K's other defining feature is its status as a semi-pro display. The foundation of its excellent performance is a gorgeous IPS LCD panel. In most regards, it's a conventional rather than cutting-edge one – it doesn't sport quantum dot-enhanced backlight or super-high refresh rate, for instance. Instead, it delivers on core image fidelity.

Subjectively, it's a lovely thing to look at, alive with convincing, natural hues, and offering plenty of contrast. The latter rated at 1,300:1, which is a useful step up on the typical 1,000:1 static contrast of most IPS panels. Out of the box, you'll struggle to find any significant flaws or defects. OK, the VP3268-4K probably isn't as punchy and saturated as ASUS's quantum dot-enhanced ProArt PA329Q, but that is a substantially more expensive panel. With its super-slim bezel, high-quality enclosure, and fully adjustable stand augmenting the classy visuals, the overall experience is extremely impressive. We also noticed an absence of input lag and decent pixel response, the latter enabled by the availability of pixel overdrive in the OSD menu. This isn't pitched as a gaming monitor, in other words, but you can still have a darn good session.

The VP3268-4K is also impressive by the numbers. ViewSonic ships it with support for an extensive array of colour spaces, including sRGB, Rec. 709, SMPTE-C and EBU, each of which is pre-calibrated to DeltaE levels of below 2.0, and confirmed in the factory calibration report. Toggling between these modes is a cinch via a comprehensive set of OSD menu options. While really serious professionals may prefer to calibrate the panel themselves, for those who lack the hardware or inclination to self-calibrate, the pre-calibrated presets will come in very handy.

The panel is also a true 8-bit affair, with support for a 14-bit look-up table; 10-bit per channel colour is also offered, albeit through dithering – for native 10-bit colour, you'd have to spend a lot more money. Overall, then, the VP3268-4K doesn't break new ground. It isn't quite the last word in pro features. It's not the ultimate gaming panel. But it is a fantastic screen at a competitive price.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★★

Fantastic IPS panel with a strong feature set and great slim-bezel style. Not quite a full-pro panel, though.

★★★★½

apc HOT PRODUCT

PC CASE

$200 | WWW.NZXT.COM

NZXT H400i

A lotta dollar for a lotta case.

Ah, micro-ATX... the bastard child of the form factor family. Sitting somewhere between the juggernauts ITX and ATX, it takes the best of both worlds, and condenses it into a feat of efficiency and expandability. If you're after a smaller rig, with support for multiple GPUs, more memory and plenty of I/O, without going huge, this form factor is a happy compromise.

Problem is, being the Goldilocks of the PC world isn't good enough in today's age of rapid releases. Manufacturers simply don't have the time to develop 'boards for this form factor anymore. It lacks the mainstream desirability of ATX and the engineering "Wow!" factor of ITX, so allocating resources to it doesn't make much sense, as far as AIB partners are concerned. And that's the problem: There's not enough micro-ATX 'boards.

Let's break it down. For a brand-new mid-range rig right now, if you're after Ryzen and X370, forget it. There are no 'boards — plenty of B350 variants, but no premium. Turn to Coffee Lake and Z370, and you'll find three. Threadripper? There's one on the way from ASRock, but it hasn't been released yet. And for X299, there's a grand total of just one 'board. Slim pickings indeed.

Seemingly, then, NZXT's H400i is a bit out of place in this world of ATX and ITX giants. It's a case that sits right in the centre of this middle-ground massacre, yet it really doesn't deserve to, because it's a fantastic piece of design. Not that that'll surprise anyone, given just how impressive its father, the H700i, is. Those clever features that NZXT crafted around the brilliant structure of that mid-tower monster migrate well into the smaller form factor of this microATX wonderdog. Whether that's the intuitively folded cable bar, the smart SSD mounts, PSU cover, smart fan controller, tempered glass and more, it all just works — and works well.

Where the H400i really shines, however, is with its cooling potential. Radiator and fan mounting compatibility is exemplary. Whether it's an AIO, custom loop or air tower that you have in mind, it's a case that can very much do it all. No, seriously — two 140mm fans in the front, two in the roof and a 120mm one in the rear for standard airflow alone make it killer for any air-cooled system. Combine that with the fact that you can pack a 280mm radiator in the front and a 120mm in the back as well, and it soon starts to turn heads in the liquid-cooling world, too. On top of that, you get that gargantuan front panel, perforated with holes along each and every side, acting as both a stylish design choice and a fantastic air intake for the two 140mms located up front.

Storage support, on the other hand, does come unstuck a little. Although you can install up to four 2.5-inch drives, there's only support for a single 3.5-inch, so that's something to take into account. Plus, of course, there are no 5.25-inch bays — they've seemingly gone the way of the dodo at this point.

If nothing else, the NZXT H400i case is a perfect excuse to migrate toward the micro-ATX form factor. Its exceptional design, brilliant use of materials and nice price savings over the bigger H700i model all combine to make it one of the best cases we've ever got our eager hands on.

Zak Storey

Verdict

Features	★★★★★
Performance	★★★★½
Value	★★★★☆

While a bit pricey on the surface and has limited 'board offerings, this case shines in just about every other arena.

★★★★½

software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Adobe Premiere Elements

Channel your inner Spielberg with the latest video editing app.

$145 | WWW.ADOBE.COM/AU

Video editing is a skill that comes with practice and study, but Adobe seems determined to slacken the learning curve with its beginner-friendly movie editor. However, with a plethora of free apps online, is it worth considering a paid one?

The additions to this 2018 addition are heavy on the automatic processing and time saving. It even claims to be able to teach you video editing. The interface remains much the same, with a preview window up top, timelines below, and fixes and effects on the right. It's an old-fashioned look now, with the icons appearing too large. Quick mode gives you a single video timeline, plus two audio ones, for quickly chopping up a movie you've made with a single camera, while Expert adds more video tracks, and opens up the number of effects available.

Adobe's machine-learning and AI research is starting to come to fruition. Auto Trim assesses your video and cuts it into just the best bits. This is likely to produce a result that needs to be looked over by human eyes, as the software can't know what was important when shooting, but it does a reasonable job of discarding bits where nothing much happens, and you can customise the algorithm to focus more on people or action. Candid Moments hunts through your footage for the best single frames to pull out and treat as still images. You're probably going to want to be shooting 4K footage to take best advantage of this feature, though.

What Elements does well is to take the hassle out of video editing and its beginner-friendly nature is one of its strongest features. Guided mode teaches you how to fix up your raw footage by removing distortion or improving a dull-looking clip with tweaks to brightness, colour and contrast. Adjustment layers, familiar to Photoshop users, make it easy to apply the same adjustments to multiple clips, and you can record narration directly into the app. There's a full suite of DVD menus and captions for you to play with.

Video editing can be daunting, and for beginners and advanced amateurs alike, the value of an app that holds your hand, but isn't afraid to let go when you want to run free, is huge. You're not going to find much better out there, even if the price may give you pause for thought in the face of free competition. **Ian Evenden**

Krita

A top quality (and free) painting program.

FREE | KRITA.ORG.COM

Krita is professional-quality painting software that's been created by a team of artists with the noble aim of putting top-notch creative tools within reach of everyone. You can use Krita for any kind of drawing and illustration, but it's particularly great for comics and manga. There are panel templates, halftone filters, and perspective tools in addition to the usual brushes, fills and pens. Each brush is totally customisable, and you can save your bespoke brushes to use again later.

Right-clicking anywhere on the canvas in Krita will bring up a selection wheel, which lets you pick a new tool and select a colour in seconds — a system that's much easier than trawling through menus and settings. Krita was created by artists for artists, and it shows in the dozens of thoughtful little touches that make it easier to create great paintings. There are handy drawing aids for creating straight lines, vanishing points and smooth shapes. You also get layers, masks, various transform tools, HDR support and advanced selection functions.

Krita is an incredibly powerful painting program, and it's a great one to add to your free-app toolkit. **Cat Ellis**

Pixelmator Pro

A viable alternative to Photoshop.

$89.99 | PIXELMATOR.COM/PRO

Pixelmator Pro is a Mac-only photo editing and graphics app, distinct from the existing Pixelmator app and with a new interface and some advanced technologies. Its single-window interface, with controls you can quickly access and hide at the edges, allows you to focus on your images instead of juggling windows. The workflow is quick to pick up, you won't waste much time delving into sub-menus, and there's a wealth of tools on offer, from advanced shapes, type and transformations to pens, selections, layers and more. The brushes are particularly responsive and fun to use. The art tools do a good job of not seeming too daunting to less experienced users while providing plenty of depth for more heavyweight tasks as well.

From a photographic point of view, there's support for RAW, as well as all other major file formats (including PSD) and very solid editing tools with control over every aspect of an image's light and colour. It's several steps up from a standard photo editing app in terms of what you can do with photos, while arguably not having the really fine-grained tools of a dedicated (and more expensive) tool like Lightroom or Capture One. Layers and masks are handled more intuitively than in Photoshop, appearing in a stack on the left of the window for easy access and editing.

The retouching tools are excellent, with easy-to-use clone and repair brushes. The repair tool is especially impressive – it was able to accurately remove even large, complex elements from a picture by simply brushing over them, and do so better than any similar tool we've used. This is assisted by the app's clever new Machine Learning capabilities, which enable it to recognise and interpret certain features within images. They require a Mac with support for Apple's Metal 2 graphics technology, but also deliver automatic, intelligent layer naming, horizon detection, and accurate quick selection tools.

Import, integration with Photos and export (including export to social media) are all well handled. So is History. The software appears to constantly save with each step and periodically save versions as well, meaning there's a Time Machine-style history option for reverting to earlier states. Plus, all edits are nondestructive.

Does it have the sheer depth of Photoshop? Probably not, but then neither does it have its complexity, or the legacy of years of cross-platform code to deal with. Pixelmator Pro is a pure Mac app: slick, gorgeous and powerful, and with more than enough features for all but the most demanding graphic artist or photographer. A one-off cost of under $90 for an app this much fun to use is also a bit of a bargain. It's an excellent choice for graphics, layout and photo editing, with an intuitive workflow.

A powerful alternative to Photoshop, which should suit all but the most demanding designers and photographers.

Hollin Jones

DropStream

Easily stream video and audio from your Mac to an Apple TV.

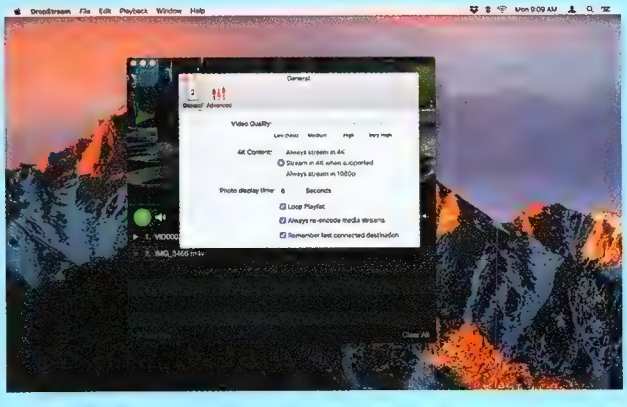
US$9.99 | AIRSQUIRRELS.COM

DropStream enables you to play videos or audio on your Mac and stream it to an Apple TV, Chromecast or any Airplay-enabled speaker. It's been possible to stream your Mac's display and audio output via AirPlay since Mountain Lion, of course, but DropStream enables you to stream only the movie files you choose and to create and loop playlists.

Installing DropStream was a bit of a chore, requiring two restarts. It even urged a third restart, claiming to have spotted yet another update it required, but we declined.

Once launched, DropStream is easy to use — just grab a video file from your Mac and drop it onto DropStream's main window. Repeat the process to build a playlist. Click an AirPlay-like icon to choose an output device to send to, then press Play to start. It works well, though there was a lag of several seconds before the video appeared on our TV.

Once you've created a playlist, you can choose to allow DropStream to loop through the playlist till you press Stop or navigate to individual videos and play them manually.



DropStream does one thing only, but it does it well. It's a particularly good way of streaming to Chromecast from your Mac, once you get it up and running.

Kenny Hemphill

Halide

Shoot in RAW from your iPhone.

$7.99 | HALIDE.CAM

Third-party camera apps are compromised out of the gate. They can't offer shortcut access from the lock screen, a handy convenience when shooting fast-moving subjects like kids and animals, which makes the default Camera app hard to beat.

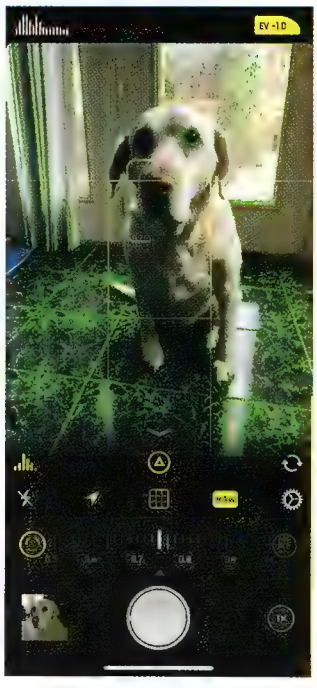
Halide is a contender to the iPhone camera app throne that caters to discriminating shooters who prefer to manually play around with settings before tapping on the shutter. The app also offers a desirable option lacking from Apple's own: higher quality Raw images. (The default is HEIC.)

You'll need an iPhone 6s or later to snap raw photos; other cool features like real-time histogram and focus peaking – which displays in-focus regions as a colour halo – require only iPhone 6 and 5s, respectively. Halide's sole nod to point-and-shoot is defaulting to smart auto mode, but manual gesture-based controls for ISO, shutter speed and white balance are only a quick tap away. Raw can't be used with flash, though.

Halide borrows a few gestures from the native Camera app, which is a nice touch considering that many third-party apps try to reinvent the wheel. The developers pride themselves on the fact the entire UI can be navigated using only one hand (which is mostly true) and takes advantage of the iPhone X's edge-to-edge screen.

When it comes to photo editing and video recording, however, you'll need to look elsewhere – Halide has no such capabilities. But for shooters who want more control over their images, this one is worth the money.

A great app to shoot – but not edit – raw photos on late-model iPhones. **JR Bookwalter**



Theodolite

It's amazing what AR can do.

$9.99 | HUNTER.PAIRSITE.COM

Apple believes augmented reality (AR) is going to be a big deal, and we're inclined to agree — whether it's Carrot's argumentative AR app or Theodolite's extraordinary measuring powers, there's something really compelling about the combination of reality and digital information. Theodolite was one of the first iOS AR apps, and its latest incarnation is better than ever.

At its simplest, Theodolite tells you where you are and what you're looking at by overlaying information on your camera's viewfinder. You can use it to measure distances, shoot on location (with up to 8x digital zoom and filters for improved visibility), triangulate via landmarks, and map your progress and position — signal permitting. Apple used it to explore the Great Wall of China but it's just as useful for a short hike.

It can use military coordinates or GPS, multiple latitude/longitude formats, and custom map markers, show your location on a map or a satellite image, share locations among teams of up to 20 (via low-cost in-app purchases — Team Tracking is $1.49), and track contours and useful landmarks. You can also enhance the core features with add-ons such as specialist maps.

Theodolite is an astonishing app, which could be useful to anyone from surveyors to sportspeople, search parties, casual hikers, school expeditions, DIY tours and snowboarders. It's also a vivid illustration of what AR on iOS can do. **Carrie Marshall**

Pixelboard Pro

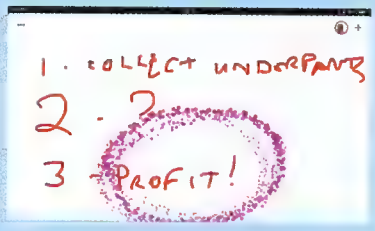
Whiteboards for virtual meetings.

FREE TRIAL, $14.99 | GETPIXELBOARDAPP.COM

Virtual meetings can be useful, but they often lack a crucial component: a virtual whiteboard where you can sketch ideas or highlight things. That's something Black Pixel encountered, and so it created a virtual whiteboard app for iOS. Pixelboard Pro enables you to share up to three boards with nine other people simultaneously. The free app is fully featured for two weeks, and if you don't then unlock it (for a reasonable $14.99), the app is reduced to one board without collaboration or gesture support. By then, you'll know if it's right for you.

The interface is very simple and straightforward, so nobody's wasting time trying to make it work when you're supposed to be working together. It works just like a real whiteboard, with the useful addition of disappearing ink that remains on the board for only a short time. The gesture tools make it easy to highlight or point to elements of the current board, and you can save screenshots to refer to them later.

It's not perfect, though. You can save images but not import them, and if you don't have a stylus, your scribbles (like ours) will look rather childish — even on an iPad Pro. Also, the app requires iOS 11, so older iPads aren't invited to the party. However, if you have dainty fingers and up-to-date iPads to work with, then it's a useful and well-priced collaboration tool. It may be too simple for some, but Pixelboard Pro is clever and useful, and not to expensive. **Carrie Marshall**



Google Play » ANDROID

pcgaming

LawBreakers Player Count Finally Dropped to Zero on PC (mp1st.com) [Misleading]

791 223 9 hours

pcgaming

Dark Souls: Remastered - Announcement

Ready For Reddit

A tidy reddit app for casual users.

FREE | TINYURL.COM/APC452-READY

Most people are well advised to stay away from reddit, but if you're among the millions who visit it every day (and there are plenty of good reasons to visit it), then Ready For Reddit is a useful way to browse. Chief among the improvements, is that it makes what is a very animated gif-reliant platform more readable. Gone are the days when you'd need to click a subject description and load a new page to see the latest *GTA V* motorcycle stunt: each subreddit page will load these automatically. Naturally (and thankfully), text-heavy threads won't automatically expand, meaning your average browse of a subreddit will comprise a long sequence of images and gifs (apparently the kids like that). The same display options for showing content are available in the app as they are on desktop, and the app runs like a breeze. Hardly revelatory, but if you're the type to visit a subreddit and browse listlessly, it's a better way to do so. **Shaun Prescott**

Google Maps Go

Light and fast

FREE | TINYURL.COM/APC452-MAPSGO

Google's new suite of Go apps are made for low-end Android devices running Oreo (Go edition), a new operating system specifically built for entry-level handsets. Maps Go looks and behaves a lot like Maps, providing directions via car, public transport, cycling and on foot, as well as business listings. What you don't get, however, is turn-by turn directions, nor the ability to share your location. The core stuff is all here, though, and for many people, it'll probably be enough. Maps Go itself is tiny — 0.09MB — and actually runs in Chrome, but as it's made for low-end devices, you may struggle to download it. Visit the Google Play Store and you'll probably see that it's unavailable for your device. If you want to trial it, go to **tinyurl.com/apc452-mapsgo** (which we've tested) and download the APK file after enabling third-party apps to be installed on your device. We'd recommend you revoke this permission once Maps Go is on your device so stop any harmful apps from downloading to your smartphone. **Paul Taylor**

Storyboard

Bam! Zap! Kapow! And now your video's a comic book!

FREE | RESEARCH.GOOGLE.COM

The latest 'appsperiment' from Google's research team involves a trio of AI-driven photography and videography tools, the most interesting of which is dubbed Storyboard. Using a combination of object and person recognition, as well as segmentation and stylisation algorithms, this app analyses any video you feed it and spits out a multi-panel storyboard, akin to a classic comic book page. If you're not happy with the result, you can swipe down to refresh it. Each new storyboard will have a fresh layout of panels, and each image will be taken from a different section and crop of your video. The art-style also changes with each refresh, cycling through a variety of sketch, brush and cut-out filters. While the ever-learning algorithm occasionally misses the mark, it's generally pretty accurate. The biggest detractor at the moment is the application of the various filters as they will often distort the scene to the point of abstraction, although this can be avoided by using clear source material. **Harry Domanski**

Darktable

Great power hidden behind a humble interface.

FREE | WWW.DARKTABLE.ORG

Over a year has passed since the last stable update of Darktable was released, so we were pleased to review this outstanding member of the open-source software world.

Darktable is a professional-grade tool for processing RAW images taken with a DSLR or any other camera that's capable for shooting images in raw format. Outside the Linux ecosystem, Darktable competes with such commercial heavyweights as Adobe's Lightroom and Apple's Aperture, and this alone confirms that Linux, in general, is mature enough to meet the tough requirements of professional photographers.

Rendering raw images and carrying out tasks such as the live preview of effects takes up a lot of CPU power. Thankfully, Darktable makes use of sophisticated, optimised code to deliver a fine degree of performance. We chose to view a very large bitmap image of the night view of the Earth from NASA. This is a massive JPEG file that weighs in at 220MB. Most Linux image viewers failed to open it, even on systems fitted with 8GB of RAM, but Darktable does the job swiftly even on low-end configs.

So what's new in version 2.4, apart from almost 3,000 commits and over 340 closed issues? The latest release features the new Haze Removal tool, which is handy for improving shots that have been taken outdoors, and fixing the effects of a dirty lens. The Local Contrast module now features a local laplacian mode, and the Undo history now supports masks. Fujifilm compressed RAFs and floating point HDR DNG files are fully supported, too.

There are many more tasty new additions for you to discover, and if you regularly play around with raw photos, you'll definitely notice improvements under the hood, too. Features such as grouping steps in the Undo history, the Tone Curve tool, de-mosaicing filter, map location tool and others all have been improved for a better and smoother user experience.

Get the latest Darktable copy from the project's website or check your distro's repositories for the update.

Midnight Commander

Browse your files like your grandpa did.

FREE | WWW.MIDNIGHT-COMMANDER.ORG

We're glad to see the latest update to this mature and venerable file manager, which is popular among both older UNIX folks and the younger generation. In our experience, most people will know how to install Midnight Commander (or MC) on Linux, because it's included in almost all distributions by default. It's slightly less common than GNU C Library, but far more widespread than LibreOffice, for instance.

Midnight Commander offers a tried-and-tested twin-panel approach to managing your files and directories. Interestingly, the traditional deep-blue panels with aquamarine selections is the type of working environment where you would probably use the 'directory' term instead of the Window-centric 'folder'. But we digress.

MC is an application that, despite its age, is still capable of being used on a daily basis. In real life, MC doesn't feel as outdated as, say, Emacs, so you can start using it without further ado. A bar running along the bottom of the screen features keyboard tips for basic file operations, such as F3 for viewing, F4 for editing, F5 for copying files and so on. However, there are still some tricks you should know, to make your MC session a bit more productive.

The first one prevents you from exiting MC if you feel like it's not your cup of tea: press 'Ctrl - O' to switch to the command line without leaving the program (press it again to get back). Use 'Shift - +' to select files and directories using your own wildcard, or press 'Shift - *' to select everything in current view. MC also enables you to open a directory in a new tab: press 'Esc - O' to open the contents on another panel. Hit 'Ctrl - U' to swap panels, or go with 'Alt - I' to make both panels identical.

Exploring Midnight Commander is a good reason to read its documentation. There are dozens more keystrokes in this file manager that can save your time and boost your productivity. MC is as solid as a cast-iron pan.

Alexander Tolstoy

BUILD A

BULLETPROOF Wi-Fi NETWORK

REVEALED: THE GEAR & KNOW-HOW YOU NEED TO CREATE A STRONG & SECURE WIRELESS NETWORK AT HOME OR WORK

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BUILD A BULLETPROOF WI-FI NETWORK
Upgrade, optimise and secure your network.

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Need an NBN-compatible DSL router to get yourself onto fibre? We look at the options.

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BROADBAND ROUTER REVIEWS
Need a modemless router that'll work with any connection type? Here are some of the top broadband offerings.

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CONNECTING TO THE NBN
Some of us have it, but most of us don't. When your time arrives, we can show you how to get on board.

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WIRED NETWORKING MADE EASY
Put your home's powerpoints to work and get the speed and stability of wired networking without the hassle of running cables.

BUILD A BULLETPROOF WI-FI NETWORK

Upgrade, optimise and secure your network with the help of Nick Peers.

Unless you've been missing in action since the Y2K Bug failed to destroy civilisation, you already have some form of networking in your home. A typical home network combines wired and wireless networking, with your main PC, possibly a printer and perhaps a games console plugged into a router using an Ethernet cable, and other devices – those in other rooms, as well as mobile devices – connecting wirelessly.

At the centre of your network lies your modem and router (or modem router if you have an all-in-one unit). This acts as a bridge between the network in your home – a Local Area Network, or LAN – and the world's best-known Wide Area Network (WAN), the internet.

It's possible you only use your network for accessing the internet, but if you're smart, you'll have found ways to use its sharing abilities to even greater effect. Why buy a printer for every computer in your home, for example, when one networked printer can be shared by all? But ask yourself this: Are you using your network to its maximum? Is it performing as fast and efficiently as it should? Could you expand your network to even greater benefit? Are there problems – Wi-Fi congestion and interference, for example – that need resolving?

In this feature, we answer these questions and more. We show you how to benchmark your network, plus reveal its topography. Then we help you determine if your router needs upgrading, and examine ways to expand your network to every corner of your home.

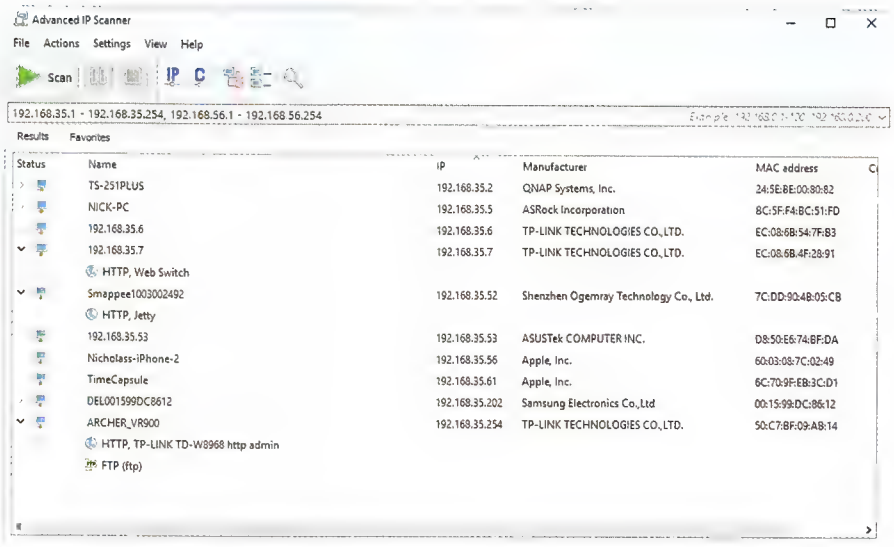
Once you've physically set things up, we look at how to optimise your network: improve security, boost range and performance, ease Wi-Fi congestion and expand its capabilities by offloading services to a network-attached storage (NAS) device. There's room for some file-sharing tips, before we show you how to access your network securely when away from home. It all adds up to one supercharged network, so light the fuse and prepare for blast off...!

Let's start by taking stock. Make a note of your existing router's make and model, then check out its specifications, which you'll need when determining whether an upgrade is worthwhile. Then take an inventory of all the devices that are currently connected to it. Don't forget any smart home tech you've added, such as a security camera or SmartThings hub.

Struggling to remember what's connected where? Use the free Fing app on your smartphone or tablet, or download Advanced IP Scanner (**www.advanced-ip-scanner.com**) on your PC to scan your network for connected devices. Both tools provide you with as much information as possible to help you identify the devices in question. In the case of Advanced IP Scanner, you're given the device name, IP, manufacturer, and MAC address – click the '>' next to an entry to reveal the resources it shares.

The inventory could reveal unwanted devices on your network – in which case, our tips on securing your network (page 48) will help you lock these out – but for most, it merely reminds you what's connected.

One last thing before we begin: Consult the box on benchmarking (over the page) to see how to perform some quick tests on your network as it currently stands. You can then re-run these as you make upgrades and optimisations to your network, to see whether they have an effect.


Advanced IP Scanner
File Actions Settings View Help
Scan
192.168.35.1 - 192.168.35.254, 192.168.56.1 - 192.168.56.254
Results Favorites
Status Name IP Manufacturer MAC address
TS-251PLUS 192.168.35.2 QNAP Systems, Inc. 24:5E:BE:00:80:82
NICK-PC 192.168.35.5 ASRock Incorporation 8C:5F:F4:BC:51:FD
192.168.35.6 192.168.35.6 TP-LINK TECHNOLOGIES CO.,LTD. EC:08:6B:54:7F:B3
192.168.35.7 192.168.35.7 TP-LINK TECHNOLOGIES CO.,LTD. EC:08:6B:4F:28:91
HTTP, Web Switch
Smappee1003002492 192.168.35.52 Shenzhen Ogemray Technology Co., Ltd. 7C:DD:90:4B:05:CB
HTTP, Jetty
192.168.35.53 192.168.35.53 ASUSTek COMPUTER INC. D8:50:E6:74:BF:DA
Nicholass-iPhone-2 192.168.35.56 Apple, Inc. 60:03:08:7C:02:49
TimeCapsule 192.168.35.61 Apple, Inc. 6C:70:9F:EB:3C:D1
DEL001599DC8612 192.168.35.202 Samsung Electronics Co.,Ltd 00:15:99:DC:86:12
ARCHER_VR900 192.168.35.254 TP-LINK TECHNOLOGIES CO.,LTD. 50:C7:BF:09:AB:14
HTTP, TP-LINK TD-W8968 http admin
FTP (ftp)
Advanced IP Scanner takes an inventory of all the devices connected to your network.

PICK A NEW ROUTER

Given the router's critical role in your network, this should form the starting point for your network tweaking. First question to answer: Is it up to the task? If you don't want your network to be hobbled by slow transfer speeds, make sure it supports the latest wired (Gigabit Ethernet) and wireless (802.11ac) technologies.

You're not limited to the modem router supplied to you by your internet provider – and if you're currently paying a monthly rental fee for it, it's likely you'll get better long-term value by purchasing your own model. If the modem and router are separate, you might even want to consider buying an integrated modem router to save on space and free up a socket, but make sure the model you pick works with your current internet connection – it's usually a choice between cable, ADSL (regular broadband), and VDSL or ADSL2+ (super-fast or fiber-optic broadband). If you're not sure about the acronyms, check with your internet provider (or ask on its support forums) for confirmation.

ESSENTIAL FEATURES

So what should you look for in your new model? Start with the wired ports – make sure your new model offers Gigabit Ethernet to maximise transfer speeds. Most routers should offer four Ethernet ports – if you have more than four wired devices to connect, or your devices are in a different room to your router, this may not be a deal-breaker. See the 'Expand your network' section (page 44) for more help in this area.

Next, choose a model that supports 802.11ac (AC) wireless networking. These days, most routers create two separate wireless networks on different channels: 2.4GHz and 5GHz. The 2.4GHz band is supported by all devices, but is where congestion and interference from neighbouring networks can sap its performance (more on mitigating this later). The 5GHz band is traditionally less congested, subject to less interference, and much quicker over shorter ranges.

The 5GHz channel's major drawback is its limited range particularly on older Wireless N routers that supported both channels. Wireless AC routers improve the 5GHz range, thanks to detachable antennae, which can identify where connected devices are, and aim the signal directly at them, using a process called beamforming.

You'll also see AC routers are rated using different numbers, from AC1600 up to AC2800. The latter number indicates the maximum combined Wi-Fi speed for the router's two channels – typically 300–600Mb/s for the 2.4GHz range, and then 1Gb/s up for the 5GHz range.

If you do a lot of streaming, you might also be tempted by a model offering Multi-User MIMO (MU-MIMO). MU-MIMO improves the efficiency of multi-device streaming by streaming multiple packets simultaneously, but beware: Behind the hefty premium is the fact that your wireless devices must explicitly support MU-MIMO, and right now, not many do.

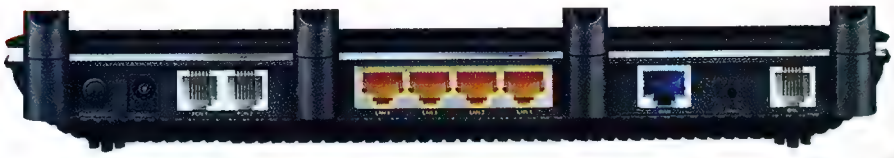
HANDY EXTRAS

Routers are becoming increasingly smart, so look out for these features: Universal Plug and Play (UPnP), which automatically opens the ports required to stream to and from the internet (albeit at a cost to security). Then there's Quality of Service, or QoS, which enables you to apply bandwidth limits to specific devices.

Some routers even offer VPN services, enabling you to set up

Use a Wi-Fi expander to extend the reach.

Netgear's Nighthawk routers offer advanced features.



Make sure your router offers enough Gigabit Ethernet ports.

TP-Link's Archer range is fast and affordable

encrypted network connections to a work network – if you're looking to set up your own VPN server, try Netgear's Nighthawk range, or see the 'Offload network services' section (page 48). Bonus points go to routers that offer USB ports for printers or external hard drives, transforming them into network devices.

All these features come with additional costs attached, so set yourself a budget and decide what, if any, additional features you need. Which router should you buy? That depends on what kind of internet connection you're using, so check out the various router reviews starting on page 49 to find the right type.

EXPAND YOUR NETWORK

Your central hub is now sorted, what next? First, if you're connecting any of your devices directly to the router's Gigabit Ethernet ports, you should check that they're using CAT5e cable. Inexplicably slow connections may be fixed by simply swapping out the cable – if your router (or switch) provides LEDs for each connected port, verify they're green (for Gigabit), as opposed to amber (for 10/100Mb/s connections).

It's likely your devices aren't all conveniently clustered around your router. Of course, you could look to run CAT5e cabling through your walls to each room using a structured home wiring setup (see **www.structuredhomewiring.com**), but that may not be practical.

If you're happy to go wireless, you might find the upgrade to a wireless AC router is sufficient to extend its range to your entire home, but if there are still 'dead' zones, where the signal is weak or non-existent, you have one of two options. The first, cheaper option is to try moving your router to a more central location, but if that isn't possible, invest in a Wi-Fi repeater, which acts as a relay. Place it in a halfway location between your router and the dead zone, and it should be able to boost the signal into that zone, although you shouldn't expect stellar performance.

You also need to create separate SSIDs for this new Wi-Fi network – how about appending something on to the end of your existing network's SSID, such as "TP-LINK_5GHz-office"? – and then pair your devices to the new network, as well as the old one. They then automatically switch between the two as required, and because they're all linked to your router, your network access remains consistent across all these Wi-Fi hotspots. Prices start from as little as $45 for Wireless N models that only extend the range of 2.4GHz networks. Wireless AC models start from around $55 for an AC750 model.

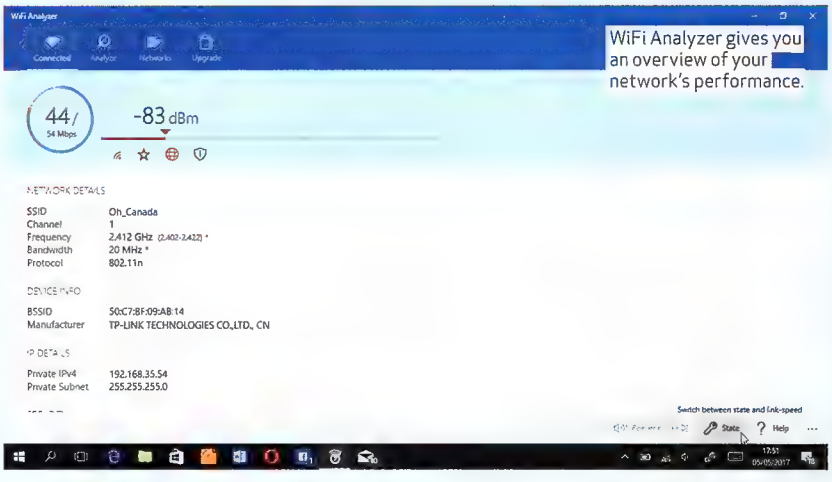
The newest trend is the emergence of wireless mesh (or Wi-Fi Mesh) systems, which combine router and Wi-Fi extender in one piece of kit. These are then sold in multi-packs to dot around your home, but come with a hefty price tag: a twin-pack Orbi system from Netgear, for example, costs $540, while a triple-pack Google WiFi System will set you back $499 for three (or sold individually, $199 each).

Benchmark your network

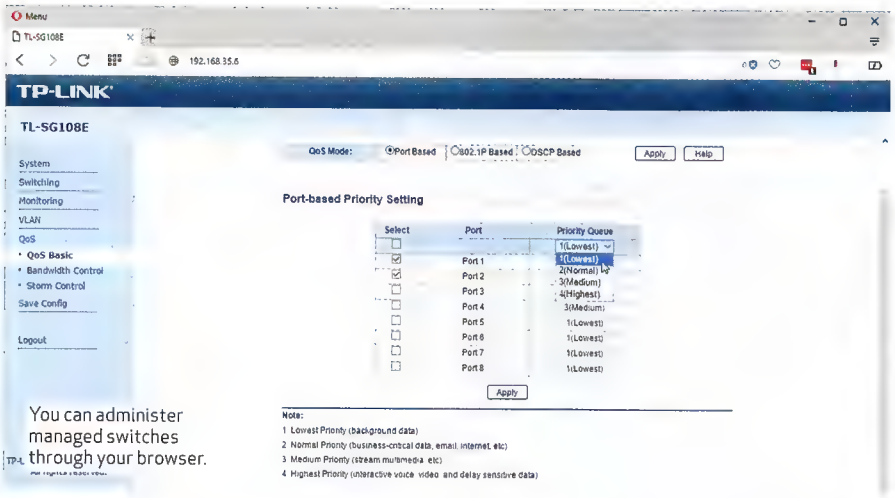
There are several tools and techniques you can employ to benchmark your network performance and range. Find out how fast your internet connection is compared to what your provider claims by visiting **www.lifewire.com/benchmark-2626177**.

If you're benchmarking with a view to streaming video, consider 5Mb/s a reasonable requirement for a single HD stream from the likes of Netflix. The demands scale up for 4K Ultra HD — 25Mb/s — but for most people, you don't need a superfast connection for one or two streams. One figure worth noting is the upload speed — this is always much lower than the download speed, but could be critical if you plan to stream video over the internet from your home network.

How can you test the strength of your Wi-Fi signal in different parts of your home? Install the free WiFi Analyzer app from the Windows Store (**bit.ly/2tnNIZ4**) on your tablet or laptop, then move around your home and record the signal strength (in dBm) and equivalent speed (Mb/s). See how far the range goes before it disappears, and try to test the 5GHz channel as well as the 2.4GHz channel.



If you would like to test your network's file transfer capabilities, download and run LAN Speed Test Lite from **www.totusoft.com/lanspeed1** on your main PC, and use it to connect to a shared folder on another device on your network. Test different file sizes (say from 2MB up to 2GB), and perform at least three tests with each, before recording the average score. Compare the results of all your tests against the type of connection you're transferring files over — 1,000Mb/s for Gigabit Ethernet, 300Mb/s-plus for wireless. These are theoretical maximums — don't worry if you're getting half these figures, but pay attention to specific results, where it seems one device or connection is struggling in comparison to other locations on your network.



You can administer managed switches through your browser.

EXTEND VIA YOUR CIRCUITS

Wireless isn't always a practical solution for extending your network throughout your home. Perhaps your router isn't in your office, where most of your equipment is kept, and you'd like to keep those on a wired network. If structured home wiring doesn't float your boat, consider extending your network through your electrical circuits using HomePlug equipment instead.

You need a minimum of two HomePlug (also known as powerline) adapters: one to place next to your router, and the other to put in the room to which you want to extend your wired network. Each adapter plugs into a spare power socket, so if you're short on sockets, make sure that you choose one with a pass-through option. Connect the first adapter to your router using the supplied Cat5e cable, then connect the Cat5e cable in your office to your wired device or — if you plan to connect multiple devices — a network switch (see 'Add a switch' over the page). Add more adapters for each room that needs them.

When all of the powerline adapters are plugged in and switched on, press a button on the main adapter, and it will automatically detect the others, extending your wired network from your router into every room in your house. Adapters of varying speeds are available but, before you begin, remember that the overall speed of your powerline network is determined by the slowest powerline adapter on it, so if you have older equipment, it might be time for you to upgrade.

Look for HomePlug AV2 models that promise a minimum 1Gb/s (1,000Mb/s) or faster, remembering that — as with all networking (and particularly the wireless sort) — the advertised speeds are theoretical maximums. Powerline equipment is notorious for being affected by 'noise' on the electrical circuit, so expect to achieve no more than half the advertised figure, and possibly less. That said, if you're transferring data between two devices on the same switch, the data doesn't need to go through the HomePlug adapter, so should transfer much quicker.

Some HomePlug models offer two or more Ethernet ports to avoid adding a switch. Expect to pay around $170 for a decent starter kit, such as TP-Link's TL-PA9020P KIT, which comprises a pair of two-port Powerline adapters, offering up to 2Gb/s transfer speeds, and pass-through sockets. For more information on powerline networks, visit **www.homeplug.org**.

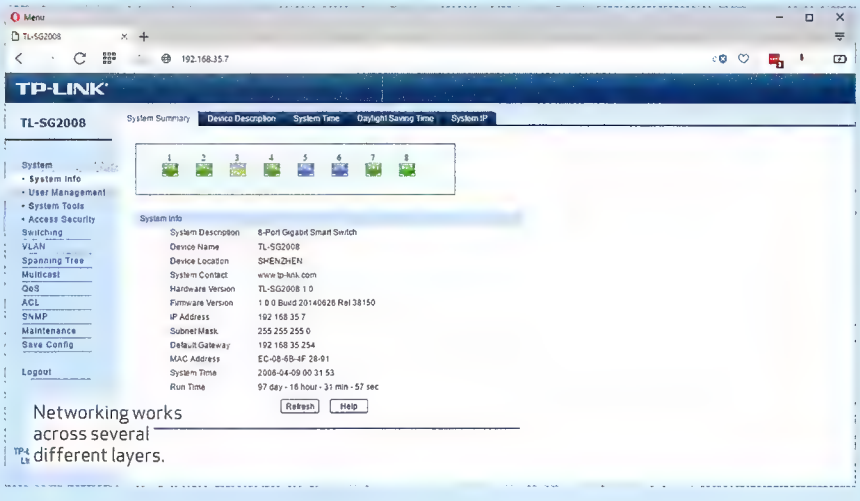
ADD A SWITCH

A network switch helps manage the transmission of data between wired

The topography of networking

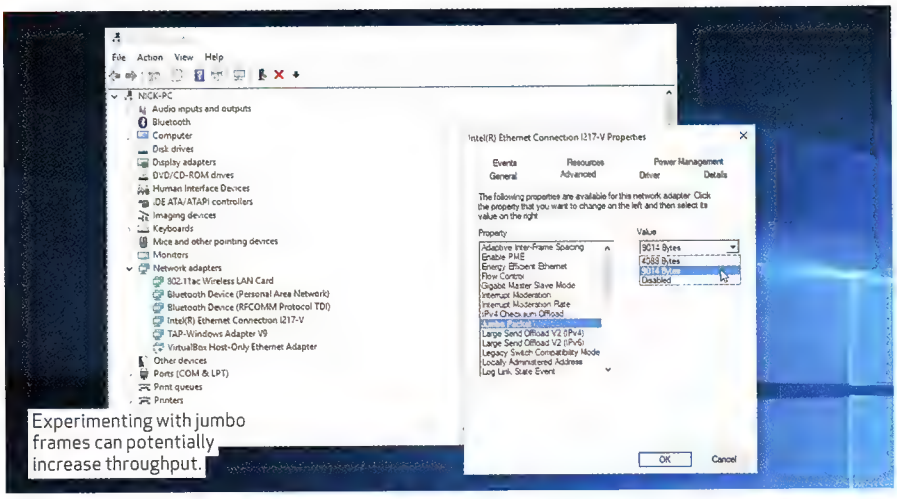
How do computers talk to each other over networks and the internet? The answer is through the TCP/IP model. TCP (Transmission Control Protocol) is the method used by computers to connect over networks, while IP (Internet Protocol) is the way in which data is transferred using 'packets' of information. This model can be broken down into four component layers: Application, Transport, Internet and Network Access.

At the top is the Application layer, which splits into three basic elements. At the very top sit the programs you use to access the internet, such as your email client. Beneath this is the 'presentation' element, where data is translated into a suitable format for sending over the network — if it needs compressing or encrypting, that happens here. Then there's the 'session' element, which determines the type of connection — or session — that's established between you and the remote computer. Examples include HTTP/HTTPS for connecting to websites and servers, FTP for basic file transfers, and SMTP for email.



Networking works across several different layers.

Beneath this is the Transport (TCP) layer. This manages how the data is delivered, by converting it into 'packets' for sending, then making sure they're safely delivered, and reassembled at the other end in the correct order. It also works in reverse for packets received by your computer. The third layer is the Internet (or Network) layer. This is the layer that covers how the data is addressed and then routed between different devices. It's also where the actual delivery of data occurs, using IP packet-switching. The final, bottom layer is the Network Access (or Network Interface) layer. This is where error detection and correction take place as the data is packaged and transported, plus it's where you'll find the physical hardware — typically Ethernet or Wi-Fi — that connects you to your network and the internet.



Experimenting with jumbo frames can potentially increase throughput.

devices on your network. If you run out of Ethernet ports, or you've extended your network to another room in your home, you need an additional switch to connect multiple devices to your router.

There are two types of switch: unmanaged and managed. Unmanaged switches are shipped in a fixed configuration and perform a similar role to older (now deprecated) network hubs, in that they simply relay the connection from your router's switch to any connected devices.

If you want more control over a specific part of your network, a managed switch will appeal. Managed switches enable you to control the network at a local level by providing certain features that give you greater control over how devices connected to the switch behave. You can, for example, apply QoS settings to manage bandwidth demands, or create Virtual LANs (VLANs) that enable you to isolate certain devices from the rest of the network, without having to physically disconnect them.

Of more practical interest is a feature called jumbo frames (also known as Maximum Transmission Units, or MTUs to their friends). Data is transferred across networks in packets known as frames, and the 802.3 standard originally defined the maximum frame size as a meager 1,518 bytes. If the devices on your network can handle it – and that includes the router and any switches – you can increase this figure to increase the size of your frames, and improve your network's performance through more efficient transfer of data: having fewer frames offers reduced resource usage and faster performance.

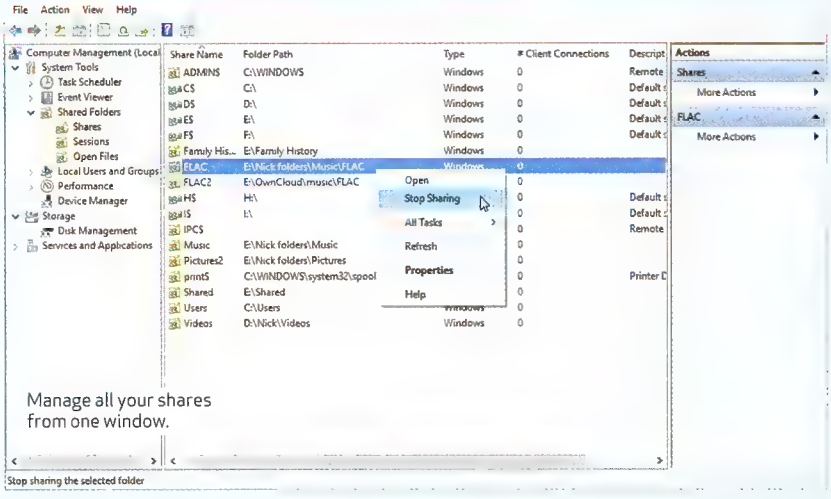
Entry-level managed switches cost as little as $40 for TP-Link's TL-SG108. It comes pre-configured to work as a dumb switch, but you can tweak its settings through its Easy Smart Configuration Utility tool. Visit **www.tp-link.com.au/faq-697.html** for a handy guide to configuring and testing jumbo frame settings. If you want more features – such as Link Aggregation support for potentially boosting your NAS drive's performance – check out TP-Link's TL-SG2008 ($80) instead.

Advanced file-sharing tips

If you've not yet done so, set up file sharing by clicking the network icon in the Taskbar notification area and choosing 'Network & Internet settings', then clicking 'Sharing options'. Expand 'Private' to verify that file and printer sharing is switched on, along with network discovery. Ignore Homegroup connections, then expand All Networks to disable public folder sharing, ensure 128-bit encryption is enabled, and switch on password-protected sharing for security reasons.

It's no longer compulsory, but a good idea to verify all your computers are on the same workgroup — WORKGROUP by default, but if you change it to something else, repeat for all the PCs in your network. Type "workgroup" into the Search box and click 'Change workgroup name' to do so.

Forgotten which folders you've shared? Windows no longer displays a folder icon to indicate shared folders, but you can get a comprehensive look (including the paths to the folders themselves) by right-clicking the Start button and then choosing 'Computer Management > Shares'. Double-click Shared Folders for a list — right-click a share to stop sharing, or choose Properties to limit the number of users that can access the share at any time.



Manage all your shares from one window.

Want to create a secret share that's not visible? Simply add a dollar symbol ('$') to the end of its name, and it won't show up anywhere in people's network browsers — the only way to access the share is to type its path exactly into the address bar of File Explorer. For example: \\COMPNAME\SecretShare$.

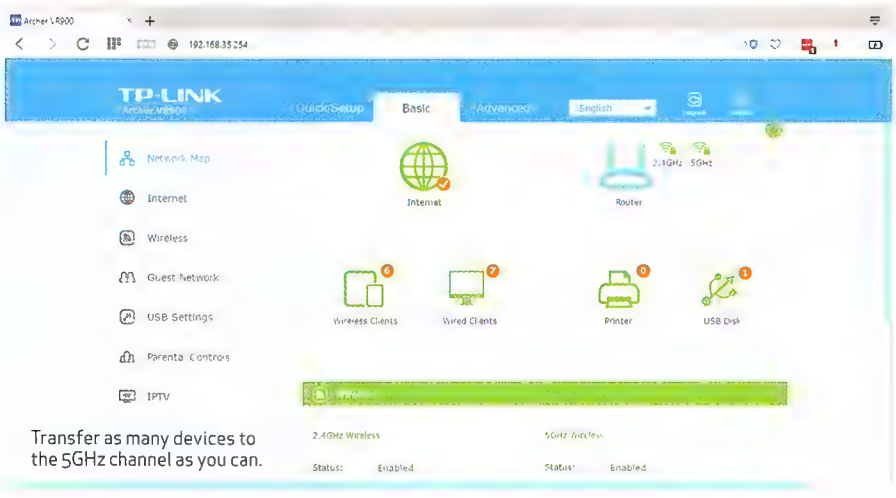
Finally, if you're signed into Windows using a Microsoft account, when you come to access a share on that PC from an Apple Mac or Linux computer, don't type your full email address into the username field; instead, type the name before the @, and it should connect to the share on your PC with no problems.

OPTIMISE YOUR NETWORKS

Now is a good time to benchmark your network again, following the advice in the 'Benchmark your network' box back over the page – you should immediately see improvements in Wi-Fi speed if you've made the jump from Wireless N to Wireless AC, and hopefully better range, too, particularly on the 5GHz channel.

The next phase of optimisation involves first moving any devices that can detect the 5GHz Wi-Fi network over to it – not only is this channel quicker, but it will reduce congestion and help balance your wireless devices' demands better. If you're having issues with the range of the 5GHz network, move your wireless device closer to your router to make the initial connection – once it's paired, your router's beamforming technology should help extend its range to your device. If there are still issues in certain areas, consider buying a Wi-Fi repeater.

Next, let's look at your 2.4GHz network. Using WiFi Analyzer (again, see the benchmarking box on page 44), switch to the Analyse tab, where you'll see a series of overlapping circles on a graph, indicating what channels are being used by your – and neighbouring – networks. A recommended channel is listed – access your router's configuration settings through your browser, and look in the 2.4GHz Wi-Fi section for a channel setting. Change this from automatic to the recommended channel. Click 'Save'. After a pause, return to WiFi Analyzer to see what effect it's had. Be prepared to experiment with different channels, and test in different parts of your home, particularly weak signal areas, to improve performance in areas that are critical to you.



Transfer as many devices to the 5GHz channel as you can.

MORE CONFIGURATION TIPS

Let's return to the router configuration utility and trawl through its settings, looking for more tweaks to perform. Start by tightening up security – if you've never done so, change the default password required to access your router. You should also change the Wi-Fi network passwords from those supplied with the router, and ensure WPA-PSK2 with AES encryption is selected.

Protect yourself against drive-by hackings by disabling SSID broadcast, enabling MAC filtering, and switching off the DHCP server, then check the firewall, and switch off UPnP port forwarding. Finally, look for a remote access option to administer your router from outside your home network – switch it off. See the 'Secure your digital ecosystem' feature in our October 2017 issue (page 47) for more details on how to apply these changes.

Away from security, try looking for

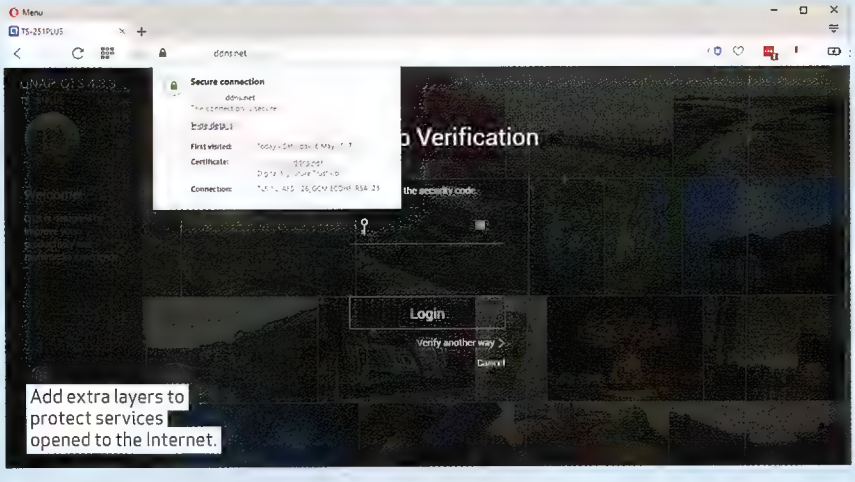
Tighten remote access security

Applications and services such as Plex are simple and relatively safe to set up for remote access, although it pays to keep an eye on any reported vulnerabilities, then disable the service until they have been patched.

One of the reasons they're safer is that you can only access them with your user credentials using an app or specific web address (such as Plex Media Player and **plex.tv/web**). They can't then leverage that connection to do anything else.

Other services, such as logging on to your NAS or even your router, are trickier, because anyone with a web browser and knowledge of your IP address or DNS address can attempt to log on — or brute-force their way — to your device.

If you are opening up a device for outside access, you'll almost certainly want to use a dynamic DNS (or DDNS) address — effectively a user-friendly web address that points to your computer's public IP address — to make logging on easier. Start by signing up for an address using a provider such as No-IP.com (**www.no-ip.com**) or similar. Link this to your device via its configuration utility, but then take additional steps to add multiple layers of security to the connection.

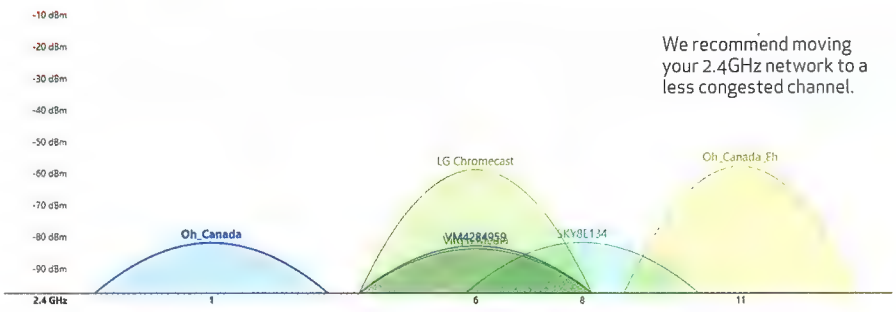


Add extra layers to protect services opened to the Internet.

First, look to force an encrypted (HTTPS) connection to the device in your device settings, then aim to back this up with an SSL certificate for your DDNS address — for example, QNAP enables you to purchase its own low-cost SSL certificate, or quickly add a free certificate from Let's Encrypt (**letsencrypt.org**).

Be sure to switch on two-step verification if it's offered, and enable Network Access Protection to block IP addresses for set periods of time (or permanently) after a set number of unsuccessful login attempts.

One last thing: ask yourself if you really need to access this device outside of your network — if you don't need to log on when you're away from home, disable all remote access.



an Address Reservation option within your router configuration's LAN settings – this enables you to apply static IP addresses to specific devices, without having to configure the device itself. One reason to do this would be if you have a device that moves from network to network – now you can reserve it a specific address on your own network, without having to change network settings when you move to another.

LOCK DOWN PROBLEM USERS

Want to manage your kids' online access? Frustrated by your housemate's hogging of your bandwidth when you want to stream video to your room? To rein in your kids, hunt down the parental control settings in your router configuration utility. You should be able to select devices by IP or MAC address, then apply restrictions, such as when they have internet access, and block sites according to rating, keyword, or other criteria. To ensure nobody monopolises the bandwidth, look for a QoS or Bandwidth Control section. You can set restrictions by IP address or range, or specific ports, which enables you to apply limits to specific applications. You can set a priority level, which only applies restrictions when other connections are in play, or set upstream and downstream limits that ensure plenty of bandwidth is left over.

OFFLOAD NETWORK SERVICES

If you're relying on your PC to provide network services, such as a media server or backup drive, now is a good time to look at transferring those to a suitable device, freeing up resources on your PC (plus enabling you to power off your PC without worrying about losing access). You could press an older PC into service, or you could invest in a mid-range network-attached storage (NAS) device. For maximum flexibility, choose between Synology and QNAP models – the QNAP TS-231 (**www.qnap.com**) is a good entry-level choice, or if you're looking for something that can handle multiple HD media streams, splash out on a QNAP TS-251+ (around $490 without disks). The TS-251+ has a quad-core 64-bit Intel Celeron CPU, and comes with 2GB RAM onboard (you can upgrade this to 8GB).

A powerful NAS lets you set up everything from a secure – and private – cloud backup to a full-blown media server. We have Plex Media Server (**www.plex.tv**) handling our media needs, coupled with OwnCloud (**owncloud.org**) for backup and sync (configured for network access only), as well as Syncthing (**syncthing.net**) for syncing media to and from the device. A USB hard drive plugged in the back expands the onboard storage, and is available for all our network devices.

Critically, what the NAS has done is allow us to reclaim much-needed system resources – it also means we no longer have to leave them switched on for network services to be available.

OUTSIDE ACCESS

It's possible to open parts of your network to the wider internet, either for personal use or to enable others to access your content. How you do this depends on what you want to share – for example, to access your Plex media collection from elsewhere requires you to go to 'Settings › Remote Access' in Plex to enable the feature. If UPnP routing is enabled, your router should do the rest; otherwise, you need to manually forward the port listed in Plex (32400 by default) to your server's IP address, using your router's configuration utility. Making other network services accessible is more dangerous, but there are steps you can take to migitate some risks – see the 'Tighten remote access security' box on the previous page. ■

Power up your router

If you're happy with your wireless router's hardware specification, but disappointed with its configuration utility or the tools it offers, you may be able to get a free 'upgrade' without having to shell out for a whole new router. Alternatively, you could breathe life into an old router by converting it into a wireless repeater or VPN server, thanks to the broad range of additional features provided by community-built open-source firmware called dd-wrt.

Start by visiting **www.dd-wrt.com** and clicking the Router Database link. Type the first few letters of your manufacturer or model to see if it's in the database and whether or not it's supported (make a note of any revision numbers, and verify your router is the same revision, usually by checking the label underneath it).

While most router manufacturers are represented on the site, not all of their models are supported.

If your router model is supported, head to **www.dd-wrt.com/wiki** to obtain its firmware, then follow the instructions to download and install it — these vary from model to model, so make sure you're following the correct advice. Typically, you're using your existing firmware's upgrade page to 'upgrade' to the dd-wrt firmware, but sometimes you may need to log on to your router via the command line.

Please note that there is a very real possibility that you'll 'brick' your router, which means it will be rendered unusable. The installation section of the wiki goes into this in great detail, and if you're put off by the process, that's not necessarily a bad thing — this is something that requires a great level of technical skill, and we're not in a position to offer any support should you decide to go down this route, unfortunately. With this in mind, we suggest trying this with an older router that you're no worried about 'losing' — perhaps even one that you've picked up cheap on eBay.

Mesh kits compared

Nathan Taylor takes a look at the top home mesh networking solutions.

Home mesh network kits first started appearing about two years ago, and since then, many of the networking industry's leading brands have released their own take on the technology.

What mesh kits do it create a seamless multi-node network that works far better than older range extenders. You can set down multiple wireless access points – as many as you need to cover your home – and wander around the house, seamlessly roaming from one access point to the next without having to reconnect or losing internet connectivity. The access points themselves create a back channel network to relay data between them and ultimately connect you to the internet, regardless of which access point you're currently connected to.

They also did something that conventional routers should have done years ago – they made setup easy. Nearly all mesh kits come with an easy user-friendly setup mobile app, something that non-technical users can quickly get going.

It's fair to say that, with the integration of mesh features into more and more conventional routers, some of the shine has come off dedicated mesh solutions. That said, we're still huge fans of the technology and the products – and we still prefer dedicated mesh solutions, thanks to their ease of use and extra features such as the dedicated backchannels and family-friendly features such as integrated mobile-managed parental controls.

What mesh network kits are used for:

- Large and multistorey homes and businesses where a single wireless router doesn't provide Wi-Fi coverage.
- Most mesh network kits include a broadband router, so they work for the same services that broadband routers do.

MESH NETWORK PERFORMANCE (IN MB/S)

	5M, SAME ROOM	15M, DIRECT TO ROUTER	15M, WITH SATELLITE 10M FROM ROUTER
GOOGLE WIFI	35.4	11.6	14.1
LINKSYS VELOP WHOLE HOME WI-FI	41.2	15.8	25.3
NETGEAR ORBI (KIT OF TWO, RBK50)	39.3	14.2	36.8
TP-LINK DECO M5 WHOLE HOME WI-FI	36	12.3	17.9
UBIQUITI AMPLIFI MESH WI-FI SYSTEM	59.4	22.2	28.3

$200 EACH | GOOGLE.COM/WIFI

Google WiFi

Smooth and easy.

The new Google WiFi is a product very much in the vein of the Ubiquiti mesh kit: a slick consumer-friendly solution that's controlled entirely with a mobile app.

Like Linksys and TP-Link, Google WiFi makes no distinction between satellite and router. There is only one product and you just buy as many of them as you need to cover your home. The first one you set up will be configured as a router, with one of the two Ethernet ports assigned as a WAN port; on additional Google WiFis, both ports will be assigned as LAN ports.

In terms of actual WiFi capabilities, it's limited to 866Mbps 802.11ac and 300Mbps 802.11n, which makes it one of the slowest products here. Relays happen in band or cross-band, so the back channel will take up some of the bandwidth that you might otherwise use for user data.

The mobile control app is as simple to use as Google could make it. There are some surprising depths, like the ability to schedule kids' internet access or cut them off, as well as the capacity to prioritise certain devices on the network. But if you're looking for deep router controls, like port forwarding or VPNs, you won't find them here. It's designed to be as accessible as possible, a device that anyone can set up and use, not just tech guys.

In all, we really like the simple symmetric design of the Google WiFi. It's not particularly fast, but it's easy to set up and manage and expanding your coverage is very easy. It's certainly not going to be the choice of power users, but as a solution for everyone else, it's elegant and capable.

Verdict

It's not the most powerful hardware around, but it's elegant and simple to use.

$290 FOR A 1-PACK; $650 FOR A 3-PACK | WWW.LINKSYS.COM.AU

Linksys Velop Whole Home Wi-Fi

A solution that does it all.

While we're not enamoured with the industrial design or the price, it's hard to argue against the Velop's capabilities. It combines elegant mobile control of the Ubiquiti with the tri-band performance of the Orbi and the simple symmetry of Google's WiFi.

Let's start with the setup. Like Google WiFi, there is only one Linksys Velop. You can buy them in packs of one, two or three, but each device is the same. The first Velop you set up will be the router, with one of the two Ethernet ports assigned as the WAN port. Additional Velops can then be added to expand the network.

The network that drives the Velop, however, is rather more powerful than that of the Google WiFi. Like Netgear's Orbi, the Velop has a dedicated wireless channel used for backhaul, so users aren't competing for the airwaves with mesh communications. That can make a huge performance difference, and it did in our tests. Both the user and the backhaul bands on the Velop are 833Mbps, which is comparable to the cheaper versions of the Orbi.

The mobile control app is excellent, on par with the apps from Google and Ubiquiti and possessed of a similar feature set. Parental controls and traffic monitoring are baked into the mobile app, although as with those other solutions you won't find advanced router settings such as firewall, port forwarding, DNS and the like in the mobile app. However, the Velop does have a fully functional Web UI similar to Linksys' other routers, so you'll get the best of both worlds. A fantastic option for everyone.

Verdict

A fantastic solution for beginners and advanced users alike, but way too expensive.

★★★★½

$550 FOR KIT OF ONE ROUTER AND ONE SATELLITE
WWW.NETGEAR.COM.AU

Netgear Orbi (Kit of Two, RBK50)

There's none better on performance.

One of the first mesh kits to become available in AU, Netgear's Orbi remains a top pick – especially the high-end RBK50 kit. It includes one router and one satellite, and gets pretty much everything right when it comes to mesh networking.

Perhaps its most notable advantage is its tri-band support. Where most mesh kits use the same radio channel for communicating between mesh nodes as they do for user communications, the Orbi has a 1,733Mbps channel devoted entirely to relaying data between the satellite(s) and router. That's a big deal, and it showed in our test results.

Users can connect to the satellite or router at up to 866Mbps, and the router and satellite both have a generous collection of Ethernet ports as well, so that you can hook up wired devices. They also both have USB ports for attaching storage devices.

Setup is very simple, since it comes more or less pre-configured in the box. You can manage and test the wireless settings using Netgear's Orbi app, though for other router features, you'll need to use a web UI just like a traditional router.

We should note that Netgear has since released cheaper versions of the Orbi, such as the RBK40 (around $470 street price) and RBK30 (around $400). These versions have a smaller backhaul network (866Mbps as opposed to 1,733Mbps) and so might not provide the same level of performance when you're connected to a satellite. You can also now purchase free standing or wall plug satellites to further extend coverage.

Verdict

Tri-band support and a massive backhaul channel make this our top pick.

★★★★★

$150 FOR A 1-PACK; $400 FOR A 3-PACK | WWW.TP-LINK.COM.AU

TP-Link Deco M5 Whole Home Wi-Fi

A family-friendly mesh solution.

TP-Link's Deco M5 is similar in many ways to the Google WiFi, but with a few added extras that will likely appeal to families with kids.

What sets the Deco apart most of all is its parental controls and antivirus. Every Deco comes with a three-year subscription to Trend Micro's antivirus and parental controls. Viruses and malicious websites are filtered before they even get to the user, and there are actual content-based parental controls built into the Deco, as opposed to just the time controls built into most competing solutions.

The antivirus and time- and content-based parental controls are baked into the mobile app. TP-Link's mobile app is very well made, comparable in quality to many of the competition. Bluetooth-based setup and monitoring is easy, and TP-Link has done an admirable job of making the app both accessible and deep.

In terms of hardware, it's very much on par with the Google WiFi, right down to the hockey-puck industrial design. It's symmetrical, so you just add as many as you need to cover your house. There are two Ethernet ports; one of these will be assigned as the WAN port on the first Deco you set up. It has the same network speed as the Google WiFi as well; 866Mbps with in-band backhaul.

It's not likely to be fastest mesh network you can get (Netgear's Orbi wins that battle), but the great app design and support for content filtering and anti-malware is a huge bonus for the TP-Link. It's a great pick for sure, and excellent value when purchased in packs.

Verdict

A great value mesh network with content filtering and anti-malware.

$550 FOR KIT WITH HD ROUTER AND TWO HD MESH POINTS ($210 FOR STAND-ALONE ROUTER; $190 FOR A MESH POINT) | AMPLIFI.COM

Ubiquiti AmpliFi Mesh Wi-Fi System

Super cool.

The product that's most credited with starting the whole mesh networking trend, the Ubiquiti AmpliFi HD is a marvel of consumer design. Not only does it look damn cool with its white cube case and physical display, it also was one of the first to eschew archaic web interfaces for a slick, user friendly mobile app.

It's available in various configurations. You can purchase the router and satellites (called Mesh Points) separately, or you can buy them in a kit. Each Mesh Point is a sleek wall-plug antenna that sits flush against the wall.

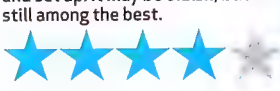
The router and mesh points support 1,300Mbps wireless for 802.11ac and 450Mbps 802.11n, although, unlike the Linksys and Netgear mesh solutions, all back channel relays happen in-band. That means that bandwidth can be effectively halved if you connect to a Mesh Point and it uses the same channel to receive and re-send. However, the fact that it supports 1,300Mbps Wi-Fi does give it a leg up over some of the competitors.

It was an absolute pleasure to set up and use, as well. A supplied app uses Bluetooth to talk to the router and Meshpoints, providing tons of speed and network diagnostic information. The app really makes a difference, and it takes no time at all to configure. Power users, however, might be frustrated by the lack of control they have over the routing functions.

Given that, we probably wouldn't use it as a primary router. Nonetheless, the AmpliFi Mesh Wi-Fi System is still a fantastic product, and one of the most fun kits to get up and running. ■

Verdict

Relatively fast, and easy to use and set up. It may be oldish, but it's still among the best.



DSL routers

Need an NBN-compatible DSL router to get yourself onto fibre? Nathan Taylor looks at the options.

In spite of the brief promise of a fibre future, good old copper is going to remain the primary connection method for a large chunk of Australians. Fibre to the node, fibre to the building and fibre to the curb will comprise the largest chunk of the NBN, and for all those services, you will need a DSL modem.

Your old ADSL modem is probably not going to cut it, however. These new services require VDSL2 support, so a lot of you will be looking for a new solution. There are plenty of options available, from sub $100 'just the basics' cheapies to a handful of wireless powerhouses with features rivalling the best broadband routers.

This month, we've looked at some of the options available to you below.

HOW WE TESTED

We tested DSL modem routers the same way we tested broadband routers (on page 55).

We performed a straight file copy test from a server attached to the router via Gigabit Ethernet. At both 5m and 15m (with two intervening plaster walls), we copied a 1GB file from the server to a laptop attached to a Linksys WUMC710 wireless bridge. The WUMC710 is capable of 1,300Mbps wireless AC. The exceptions were the Billion and DrayTek routers, which do not support 802.11ac; for that we used a 300Mbps Intel wireless adapter.

As always with wireless tests, there is certainly a case of your-mileage-may-vary. The numbers presented are only useful for comparison, and are not necessarily an indication of what you might get in your specific home environment.

What DSL routers are used for

- ADSL services
- Fibre to the node (FTTN), fibre to the building (FTTB) and fibre to the distribution point/curb (FttDP/FTTC). These all use VDSL
- Many DSL routers also have Ethernet WAN ports (or LAN ports that can be reassigned) and can also perform the functions of broadband router.

BROADBAND ROUTER WIRELESS PERFORMANCE

COPY SPEED (MB/S)*		
RANGE	5M	15M
BILLION BIPAC 8920NZ*	8.9	4.2
D-LINK COBRA AC5300	64.4	32.8
DRAYTEK VIGOR2760N DELIGHT*	9.2	5.3
NETGEAR NIGHTHAWK D8500 TRI-BAND WIFI VDSL/ADSL MODEM ROUTER	61.3	28.5
TP-LINK ARCHER	63.9	27.4

TESTED USING A 1GB FILE COPY FROM PCS ATTACHED TO ROUTER AND A CISCO LINKSYS WUMC710 ADAPTER/BRIDGE, EXCEPT THE 802.11N ONLY BILLION AND DRAYTEK, WHICH WERE TESTED WITH AN INTEL 2X2 WIRELESS ADAPTER.

$650 | WWW.BILLION.COM

Billion BiPAC 8920NZ

Connectivity out the wazoo.

One of a handful of routers that we've seen with integrated dual SIM slots, the Billion BiPAC boasts nearly unrivalled connectivity. It supports DSL, of course, and the aforementioned SIM slots allow it to also function as a 3G/LTE router without the need for a USB modem. You could just rip the SIM out of your phone if you wanted to. There's also a Gigabit WAN port, so it can function as a broadband router for FTTH services, as well.

But all this connectivity comes at a hefty premium. This is one very expensive router, and the rest of the package does nothing to justify the price. There's only a single USB 2.0 port and a standard suite of Ethernet ports. The wireless is two generations out of date, supporting only 300Mbps N – you're best off with an external wireless solution like a mesh kit.

Both the design and configuration are also dated. Billion's industrial design seems rooted in the year 2000, while its web administration console has also been teleported from the last century. It's complicated, with few help systems, and you can forget about using a mobile to set the router up.

There are some nice things here, though. It supports VPNs out of the box, for instance, but that's not really that big of a selling point anymore: many routers do that, as do third-party firmwares. The VPN setup is neat and straightforward, however, and the router does support failover settings for its different networks (so if your DSL goes down it can automatically switch to LTE).

Verdict

Lots of connectivity options, but way, way too expensive for the hardware.

$650 | WWW.DLINK.COM.AU

D-Link Cobra AC5300 DSL-5300

Power overwhelming.

D-Link's ginormous space-crab routers have finally got a modem attachment. Just as with Netgear's Nighthawk D8500, D-Link's new Cobra router puts a lie to the notion that DSL modem routers lag a generation behind the best broadband routers. This is a router with the lot, including the fastest wireless available in consumer routers.

It really is enormous. Like D-Link's top-end broadband routers, the Cobra has a large footprint and a unique design. Eight antennae circle the central pyramid, allowing the router to generate two independent 4x4 MU-MIMO AC networks, each capable of 2,137Mbps. And the wireless is fast. Tested using a 3x3 MIMO client device, it was the fastest modem router we've tested, likely being limited more by the Ethernet at short range than by the limits of the Wi-Fi.

There's a lot of power under the hood, as well. It's driven by a quad-core 1.8GHz processor – most routers have dual cores in the 1–1.4GHz range. Sadly, the firmware doesn't make the best use of this power. D-Link's firmware is perfectly solid these days – accessible with easy-to-use mobile apps – but it doesn't have the features you'd find in an ASUS or DrayTek. It would have been nice if it supported D-Link's own Whole Home Wi-Fi roaming technology, though. It does have some limited VPN support and solid parental controls.

Like the Netgear, this is a very expensive router, and you're paying a big premium for high-end wireless. If you're prepared to pay that, however, there's no wireless router more powerful.

Verdict

It's damn fast, but it would be good if the firmware made better use of its power.

★★★★☆

$310 ($245 FOR VERSION WITH NO WIRELESS AS ALL)
WW.DRAYTEK.COM.AU

DrayTek Vigor2760n Delight

Powerful corporate features.

DrayTek has a large array of DSL modem routers, from the minimalist Vigor120 up to VoIP/VPN/SIM slot toting corporate routers. The Vigor2760n range sits in the middle.

We've looked at the base Vigor2760, which lacks any wireless at all, as well the Vigor2760n which has 300Mbps 802.11n support. Both routers have full access to DrayTek's powerful firmware. This firmware boasts a suite of tools not normally available on consumer routers.

You'll find some very comprehensive VPN tools available on the platform, with up to two simultaneous tunnels supported. It will support USB LTE modems attached to the USB port, with load balancing and failover as options. It has content filtering options, as well as advanced session and bandwidth limits (perfect for preventing you from going over your 3G volume budget). There's LAN segmentation, sophisticated QoS and SNMP management support and quite a bit more.

It's not a router for the neophyte, however. There are few guides and wizards, no easy mobile setup tool and very little explanation of what everything means. Most people can probably get the basics up and running, but if you want a deeper dive, then you'll need some know-how.

Still, if you can get over that hurdle, this is an affordable modem router with a lot of business-friendly capabilities. The wireless on the 2860n is not particularly powerful, but if you're looking at an external wireless solution, it's certainly a product to keep in mind.

Verdict

Lots of high-end features in an affordable router.

★★★½☆

$620 | WWW.NETGEAR.COM.AU

Netgear Nighthawk D8500 Tri-Band

All the things.

Usually DSL routers tend to lag a generation behind broadband routers when it comes to integrated tech. With the D8500, Netgear makes an exception to that rule.

Although it's rather more compact than most other AC5300 routers thanks to the use of four internal antennae, it is indeed a full tri-band 4x4 MU-MIMO wireless solution, which is about as good as you can get in a consumer product. And if that weren't enough, Netgear has thrown in six Ethernet ports on top of the usual four, as well as a physical WAN port so that it can function as a broadband router.

Netgear's firmware is another high point for the router. It fully supports configuration from a mobile or a web interface, and it boasts some of the best family features to be found in a router. Its uses OpenDNS for site filtering – which any router can use – but Netgear bakes it right into the firmware and app. You can actually configure exemptions in the mobile app, so you can still enjoy your adult fare while the kids are protected.

There are other really useful features built in, too. The ability to remotely access USB shares over the internet, remote router management, a set of PC tools that will automatically back up to USB hard drives attached to the router, excellent media serving tools... Netgear continues to add great features to its firmware, and has managed keep it easy to use.

As you'd expect, however, this is not a cheap modem router. But given its advanced tech and excellent features, $600 is not an insane a price to pay.

Verdict

It's expensive, but has nearly everything you could ever want.

★★★★½

$350 | WWW.TP-LINK.COM.AU

TP-Link Archer VR2800

A nice balance.

If you want something high-end, but the Netgear D8500 is perhaps just a bit too rich for you, then the new TP-Link Archer VR2800 might be a very nice compromise. It's a router with excellent specs without going nuts, as well as a solid set of tools and features.

While it doesn't have the tri-band fanciness of the Netgear, it still offers 4x4 MU-MIMO wireless, enough to support even a large household of streamers and downloaders. It delivered when it came to our test results, too, maintaining surprisingly high speeds at range.

It also makes good use of its twin USB 3.0 ports, with support for both USB storage and 3G/LTE modems. The latter can be configured as a failover or even load balanced with the DSL services, ensuring that, even if the DSL network goes down, you'll always have internet access.

It can be set up using a standard web UI or TP-Link's Tether mobile app. While the web UI still isn't up to the standard of ASUS or Linksys, the mobile app has continued to improve and is now the best way to get the router up and running. It gives you access to most of the router's major features, including internet setup, wireless and time-based parental controls.

Although it's a relatively vanilla product, we actually really love the balance that TP-link has struck with these mid-to-high end consumer routers. It's not loaded down with stuff that most people probably wouldn't use, but it has very capable hardware and some very useful features like 3G and VPN support. ■

Verdict

A nicely balanced router. Good hardware without going nuts.

★★★½☆

Broadband routers tested

Need a modemless router that'll work with any connection type? Nathan Taylor has a look at some of the top broadband offerings.

Of all the different broadband technologies used in the multi-technology mix NBN, only two – FTTN and FTTC – require that you buy a modem router. For all the others, all you'll want is a broadband router. These routers have an Ethernet WAN port, and that's all that's needed for FTTH, HFC, fixed wireless and satellite. On those services, the modem is built into the NBN equipment when it's installed in your home.

Broadband routers aren't only for those particular NBN users, however. Many people looking to supplement their existing modems or modem routers also look for a broadband router. There are features available in many broadband routers that just can't be found in many DSL devices, most especially high-performance gaming optimisation. There are a number of broadband routers right now that specialise in gaming performance, and they can really deliver if your network is congested with other traffic. You can just put your modem router into bridged mode and then use your broadband router as the primary routing device.

Whether you're a new NBN subscriber or performance gamer, we've looked at five of the most capable models of broadband routers on the market. If you're looking for the latest tech, these are a good start.

What broadband routers are used for:

- Fibre to the home, HFC, satellite and fixed wireless NBN services
- If you have an existing modem router but are unhappy with its routing capabilities; you can continue to use just the modem function on your original modem router
- If you have a 3G/LTE modem that you'd like to share on your home network — note that this is only available on some router models
- As a secondary or primary wireless access point, with routing functions disabled — broadband routers are often cheaper than dedicated access points

BROADBAND ROUTER WIRELESS

RANGE	COPY SPEED (MB/S)* 5M	COPY SPEED (MB/S)* 15M
ASUS ROG RAPTURE GT-AC5300	66.8	20.5
D-LINK EXO AC1900 WI-FI ROUTER DIR-879	54.3	23.3
LINKSYS WRT32X GAMING ROUTER	60.3	24.2
NETGEAR R9000 AD7200 NIGHTHAWK X10 SMART WIFI ROUTER	63.9	25.4
TP-LINK ARCHER C3150	64.4	28.6

TESTED USING A 1GB FILE COPY FROM PCS ATTACHED TO ROUTER AND A CISCO LINKSYS WUMC710 ADAPTER/BRIDGE.

apc HOT PRODUCT

$600 | WWW.ASUS.COM/AU

ASUS RoG Rapture GT-AC5300

Simply amazing.

A tweaked version of the RT-AC5300, ASUS's GT-AC5300 is designed to be the gamer's fantasy router, the ideal platform for minimising lag. And not only does it pull that off, it does it with style.

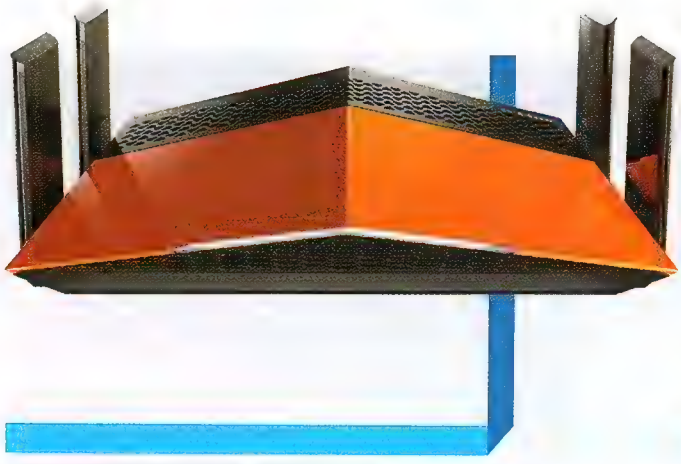
It's a full AC5300 wireless router with MU-MIMO – which is pretty much the most powerful consumer wireless money can buy. The number of LAN ports has been increased to eight (compared to the four on the RT-5300 and most others) and both USB ports support USB 3.0. It's all run on a very powerful 1.8GHz quad-core processor.

For gamers, it's perhaps the tweaks to the software that will make the most difference. ASUS has gone all-in on game optimisation. In addition to normal quality of service settings, two of the LAN ports are designated as gaming ports and traffic from those ports will receive routing priority. One of the wireless LANs can also be designated as having traffic priority for gamers and video streaming. It supports the WTFast network natively, which is a special gamer routing network, and if the router is connected to a VPN you can designate ports that bypass it – so you can use the VPN for most traffic, but bypass it for gaming.

All this is supported by the best firmware in the business. AsusWRT manages to be both user-friendly and extremely powerful, with excellent mobile apps and features commonly found only in corporate routers. ASUS even recently added mesh networking (called AiMesh) with seamless roaming between access points. In all, it's an amazing router with everything.

Verdict

A gamer's fantasy. A well-made router with the best of everything, if you're willing to pay the price.



$270 | WWW.DLINK.COM.AU

D-Link EXO AC1900 Wi-Fi Router DIR-879

Longer wireless.

Although D-Link does offer huge tri-band routers in its range, we found ourselves more interested in the newer and smaller EXO AC1900. For the most part, it's a fairly straightforward (but very cool looking) low-to-mid-range broadband router. But with a signal amp boasting up to 1,000mW of power, it promised to deliver whole-home Wi-Fi coverage from a single access point.

In our tests, at 15m, it held its signal well, meaning that it will work just fine as the sole wireless access point in most homes. That said, it's disappointing that it doesn't support D-Link's own Whole Home Wi-Fi tech, a mesh-like technology that lets you extend networks with multiple access points and wander seamlessly between them without needing to manually switch access points. If you do anticipate needing range extenders, this may not be the product for you. D-Link has made its routers much easier to work with in recent releases. Its updated firmware is very consumer-friendly, with graphical help and a simplified setup. The D-Link Wi-Fi mobile app is also much improved, although we still think D-Link could do more to hide some of the arcane stuff in the app. As a nice little touch, there's also a hard switch on the router for switching between router mode and access point mode, a nod to the fact that many people buy broadband routers just to use as access points.

It doesn't have anything to it that will really wow you, and its lack of USB ports could be a deal breaker, but it looks unique, is easy to use and works well at range. Sometimes, that's all you need.

Verdict

An affordable (and stylish) long-range router.

★★★☆☆

$350 | WWW.LINKSYS.COM.AU

Linksys WRT32X Gaming Router

A more affordable gaming router.

The WRT32X is Linksys' attempt to deliver a router targeted at gamers. While Linksys hasn't gone full gonzo like ASUS did with its GT-AC5300, it has nonetheless delivered what is a very capable (and far more affordable) gaming router.

The basic specs are high-end without being extreme. It's a dual-band 3x3 MU-MIMO router. It is unusual in that it supports 160MHz bands for 802.11ac (the first consumer router we've seen that does that), allowing it to hit 2,600Mbps without resorting to tri-band. To get 2,600Mbps, however, you would need a client device that also supports 160MHz bands – most only support 80MHz and would be limited to 1,300Mbps.

There's a quad-core 1.8GHz processor under the hood – very powerful for a router. Perhaps more significantly, it also has a completely re-engineered firmware setup with a much greater focus on gaming performance. There's a neat performance meter, as well as a completely new Quality of Service system that allows you to quickly change traffic priorities for gametime. By turning 'Killer' on, your games will be prioritised over all other traffic on the network. It's neat, and it really works.

While it doesn't have some of the ASUS GT-AC5300's fancy features like VPN bypass WTFast support, if you're looking for a more affordable gaming router, the WRT32X certainly fits the bill. It's easy to use, not overly large and does the main thing you want a gaming router to do: make sure your game data gets the highest priority on the network.

Verdict

A relatively affordable gaming router. Solid specs, and a very accessible QoS system for games.

★★★★☆

$630 | WWW.NETGEAR.COM.AU

Netgear R9000 AD7200 Nighthawk X10 Smart WiFi

Next gen wireless.

WiGig, the common name for 802.11ad, has been floating around for a few years now. Using extremely high frequencies, WiGig can transfer data at up to 7.2Gbps – far faster than 802.11ac. But because it can't travel through walls, it's essentially limited to same-room usage. That last factor has generally made it a non-player, something that hardware manufacturers never bothered with because nobody had any use for it.

VR changes that. In theory, VR headsets could use 802.11ad for wireless connectivity. No actual headsets do that yet, but the Netgear R9000 preps you for the day that they might. It's one of the very few routers on the market that supports 802.11ad, at up to 4,600Mbps in this case.

The Netgear is a powerful 4x4 wireless router with MU-MIMO support. Its wired support is also top-shelf with six LAN ports, port aggregation and a 10Gbps SFP+ port – those are used for super-fast access to NAS devices that support dual-Ethernet or 10GbE. It's all driven by a 1.7MHz quad-core processor. It's very impressive hardware.

The firmware is excellent, retaining Netgear's easy setup system, great mobile apps and good family support. The Plex media server is now built into the firmware, and Netgear's parental controls, although not perfect, are a slice above the rest with inbuilt support for customised per-user content filtering.

We have a sneaking suspicion that you'll probably never actually use 802.11ad, but even without that, it's still a cut above most of the competition.

Verdict

This is a powerful, capable and easy-to-use router with the addition of 802.11ad.

★★★★½

$290 | WWW.TP-LINK.COM.AU

TP-Link Archer C3150

An affordable all-rounder.

Although TP-Link's product range runs the gamut from $70 cheapies to monstrous AC5400 routers with forests of antennae, we're fans of its affordable mid-range products, which strike a nice balance between price and features. The Archer C3150 falls nicely into that category, offering very good wireless without being ridiculous.

The wireless is 4x4 MU-MIMO, capable of speeds up to 2,166Mbps. That means that it has enough oomph to support a mid-to-large home with multiple users streaming in HD or even UHD at once.

It's also a nice looking router (something that can't be said for all of TP-Link's range), elegant enough for public placement.

We haven't always been fans of TP-Links firmware, and we still think it has a little ways to go to catch up in terms of usability when compared to the likes of Linksys, D-Link and ASUS. But TP-Link's improved mobile apps more than make up for it, and now provide a slick setup process and access to most of the routers important features, including schedule-based parental controls and USB device management. Unfortunately, there are some things you'll still need to use the web admin for. For instance, TP-Link supports VPNs as a client, which is great, but you'll need to dive into the web UI and dig for it a little to set it up.

It did manage to perform very well in our tests, and at $270, it's significantly cheaper than most tri-band devices. For home users, that makes it a nicely balanced router, affordable but capable of delivering top wireless speeds. ■

Verdict

A great mid-range router, a great compromise between cost and performance.

★★★★½

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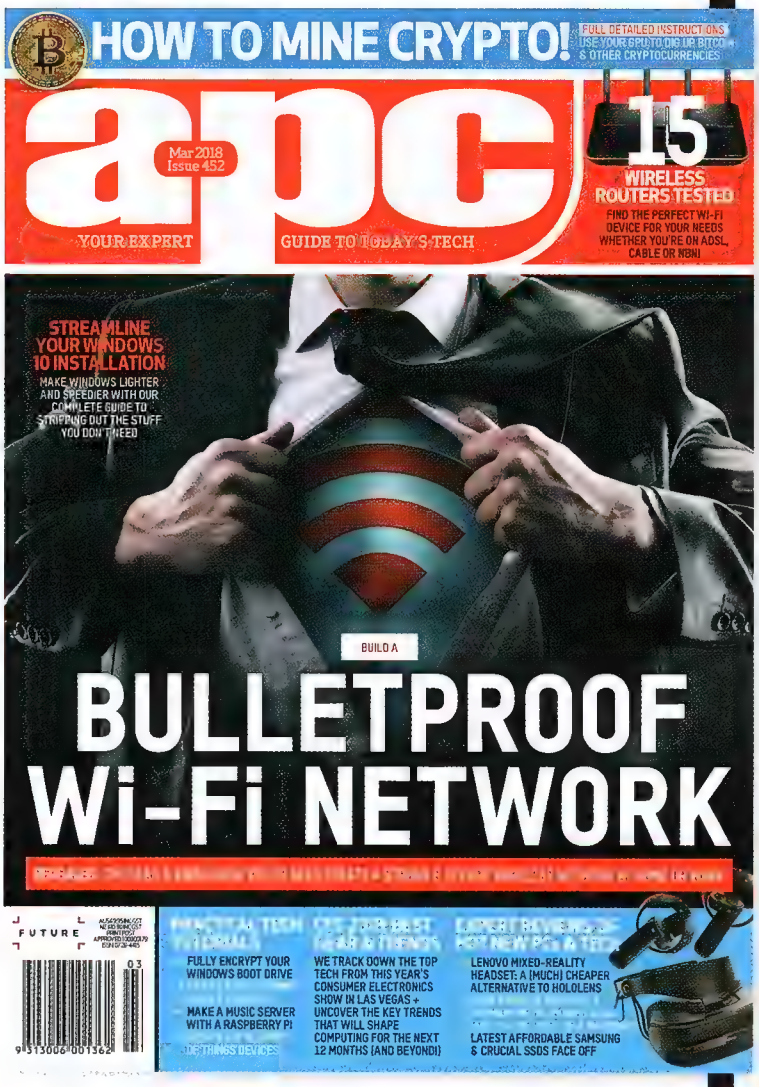
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FULL DETAILED INSTRUCTIONS USE YOUR GPU TO DIG UP BITCOIN & OTHER CRYPTOCURRENCIES
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A broadband router is needed for FTTP, HFC, fixed wireless and Satellite. The WAN port on the back will be an Ethernet port (the same size as the LAN ports).

Connecting to the NBN

Some of us have it, but many still don't. When it's time to connect, Nathan Taylor will show you how to get on board.

The new multi-technology mix NBN has been something of a movable feast when it comes to technology. The rollout plan has been readjusted multiple times, and for those still waiting for the NBN, sometimes it may seem that the plans for your area change by the week – particularly if you're in an area that was originally scheduled to get HFC access.

Fortunately, the plans do seem to have settled down a little of late. If you head to **nbnco.com.au** right now and perform a search on your address, you'll get a date and a connection type that's more certain than it has been previously.

Of course, now you'd like to know how this whole thing works, and what you'll need and what you'll have to do to set it up when it comes to your area. The answer to that really depends on what flavour of NBN you'll be getting. There are seven possibilities.

FIBRE TO THE PREMISES (FTTP)

WHAT YOU NEED: A BROADBAND ROUTER

With FTTP (also known at fibre to the home/FTTH) most of the equipment needed is built into the box that gets attached to your house during installation. All you will need is a generic broadband router with a Gigabit Ethernet WAN port (many current DSL routers also have a gigabit Ethernet WAN port, and can indeed be used with FTTP).

The installer will attach a utility box to the outside of your house, as well as a connection box and power unit inside your home. The connection box has a Gigabit Ethernet port on it (called UNI-D). It's into this that you plug an Ethernet cable and connect it to the WAN port on your broadband router. Your landline telephone also plugs into this box.

For most ISPs, the broadband router just uses DHCP for configuration, which is the default setting on most such routers. Some ISPs still use PPPoE with a username and password, however; for those, you'll have to use the router's setup wizard.

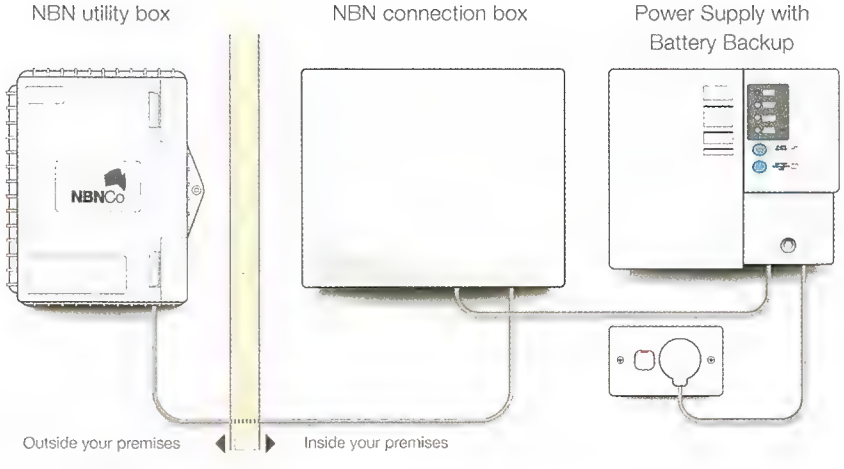
HYBRID FIBRE-COAX (HFC)

WHAT YOU NEED: A BROADBAND ROUTER

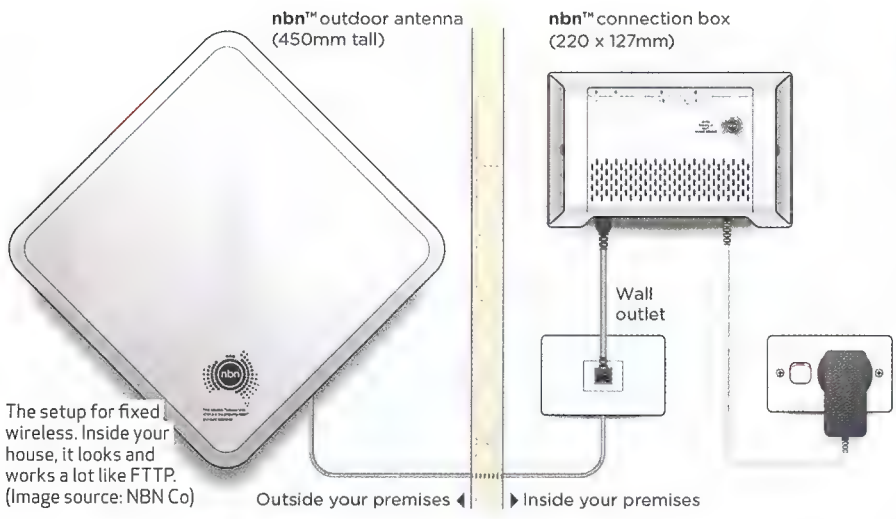
HFC uses the cable network laid out during the Foxtel Pay TV rollout to deliver data.

If you currently have HFC connected to your home, there probably won't need to be any changes or anybody coming into your house. If you've never had cable TV or cable internet, however, an installer will need to come in and set it up. Typically, a wall plate will be set up into which a coaxial cable can be plugged.

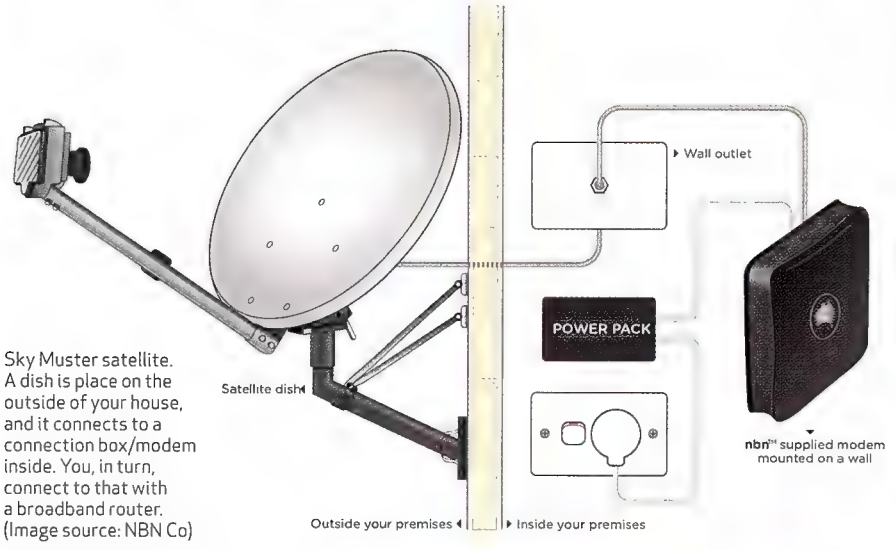
As part of the setup process, NBN Co will provide you with a cable modem, which will just be called 'the NBN connection box.' It's a freestanding box that will replace your existing cable modem if you have one. The HFC cable from the wall socket plugs into this box. You will then need a standard broadband router to plug into this box, which you will have to get yourself. You run an Ethernet cable from the WAN port of the broadband router



With FTTP, a utility box is installed on the outside of your house and connected through the wall to a connection box and power supply. Your broadband router and phone handset plug into the connection box.



The setup for fixed wireless. Inside your house, it looks and works a lot like FTTP. (Image source: NBN Co)



Sky Muster satellite. A dish is place on the outside of your house, and it connects to a connection box/modem inside. You, in turn, connect to that with a broadband router. (Image source: NBN Co)

to the UNI-D port on the connection box. The NBN connection box for HFC has no phone support. It's expected that you'll use either VoIP for voice, or you can continue using your copper landline for phone calls.

FIBRE TO THE NODE (FTTN)

WHAT YOU NEED: A VDSL2 MODEM ROUTER

With FTTN, fibre is being run to street-side cabinets, with only the last few hundred metres to your home using the old copper network. For a user perspective, FTTN looks and works a lot like ADSL. No new equipment is installed in your home and nobody needs to visit your premises. Your current phone line will remain your link to the internet, and will continue to be used for regular phone calls. There will need to be one change on your end. Your old ADSL router may not cut it anymore. You'll need a modem router with support for VDSL2, the updated DSL standard being used for FTTN. Many newer ADSL routers also support VDSL, but older routers do not.

FIBRE TO THE BUILDING (FTTB)

WHAT YOU NEED: A VDSL2 MODEM ROUTER

For multi-dwelling units (like unit blocks), NBN Co is implementing a system similar to FTTN. But instead of street-side cabinets, the node will be installed in the telecommunications room of your unit block. You building's internal copper wiring will still be used for those last few metres between you and the comms room, however.

Like FTTN, the only thing that changes on your end is the need for a VDSL modem. Nobody should need to come into your apartment.

In the next few years, there is the potential for FTTB to be upgraded. Because the distance between the node and unit is so short, it's possible to use G.Fast and XG.Fast. These are new DSL standards that can push the maximum speed up to 1Gbps and 10Gbps, respectively, over short copper wires. They will require new modem routers.

FIBRE TO THE DISTRIBUTION POINT/CURB (FTTDP/FTTC)

WHAT YOU NEED: A VDSL2 MODEM ROUTER AND A REVERSE POWER UNIT

FttDP (which is being called fibre to the curb/FTTC by NBN Co) is a new technology that's set to start rolling out next year. It's coming mainly to areas that were previously serviced by Optus cable. It was originally planned that those areas were to get HFC, but the poor state of the Optus network forced changes. FTTC is also likely to come to areas where power supply issues prevent the installation of a street-side FTTN node.

With FTTC, a 'micro node' (or a 'distribution point unit') is installed in the telecomms ditch or on the telegraph pole out the front of your house. This micro node only services a small handful of houses – typically one to three houses. Rather than drawing electricity from the power grid like an FTTN node does, the micro node actually draws powers from the homes of the users. It's expected to draw, on average, about 6W (that's 0.144kWh per day if you're concerned about the electricity costs); though it might be up to 14W if yours is the only house connected to the micro node.

Otherwise, it looks and works a lot like FTTN. You need a VDSL modem to access it, and you also need what's called a reverse power unit which plugs into a power point in your home and feeds power down to the micro node through the phone line. Likely, the RPU will be sent when you sign up for the service. You probably won't need an installer to come or any changes to be made inside your home, since it uses your existing copper wires for both power and data.

Like FTTB, the short copper runs of FTTC do offer the potential for technology upgrades. NBN Co has already started G.Fast and XG.Fast trials, which potentially offer user speeds of 1gbps or more. They will require new modem routers, however.

FIXED WIRELESS AND SKY MUSTER SATELLITE

WHAT YOU NEED: A BROADBAND ROUTER

Much like FTTP, an installer will need to come to your house and install equipment, which will include a connection box attached to a wall inside your home, similar to that of FTTP. On the outside of your home, a satellite dish or fixed directional outdoor antenna will be permanently attached and aligned.

To use it, you connect to the connection box with a general broadband router (just as with FTTP).

Why is the NBN so slow?

One of the persistent complaints about the new NBN is that it's way slower than was advertised. Many people are reporting speeds far below what they signed up for. Why is that?

There are actually two reasons here. One is the fault of NBN Co for using a technology that has highly variable speeds. One is the fault of ISPs (called RSPs in NBN Co parlance) for not providing enough bandwidth for their users. Let's look at each in turn.

DSL is bad

One of the reasons you may not be getting the advertised performance is that the largest chunk of the NBN — the people on FTTN, FTTB and FTTC connections — still uses DSL technology. It's using VDSL, which is essentially just an upgraded version of ADSL.

Like ADSL, VDSL gives "best effort" speeds. It has a theoretical maximum and you'll get some proportion of that depending on the quality of the copper lines and how far away from the node you are. So even if you sign up for a 100Mbps internet service, you might get a much lower rate because your VDSL connection is syncing at a low rate.

There's not much you can really do about this, aside from paying to have fibre run to your home (which you can do through NBN Co's Individual Premises Switch program), but it will cost you. *A lot*. Otherwise, it's best to just downgrade your plan to 50Mbps or 25Mbps to at least save money.

RSPs haven't kept up

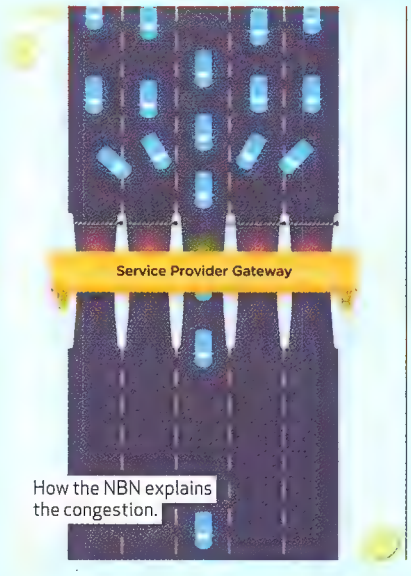
The other factor, and likely the bigger one, is that RSPs have been rushing to sign up NBN users without upgrading their networks to support them.

The thing is, your internet speed is much more than about how fast your local connection to the node, hub or exchange is. From the node, the data from your house is joined with the data from all the other nearby houses and has to be carried back across fibre links to the RSP's data centre and then plugged into the internet.

This is collectively known as backhaul. Now ISPs have never had enough backhaul to support all their users running their internet connections at max at once. They assume that, at any given time, most of the users won't be using the internet at full speed. They instead commissioned backhaul according to a target "contention ratio", which is the ratio of user broadband to backhaul. For example, let's say there that 100 users with 100Mbps connections were connected to a local node. That's 10,000Mbps total bandwidth. But the ISP figures they only will collectively only use 1,000Mbps at once, so it sets up a 1,000Mbps backhaul link. That would be a 10:1 contention ratio. Of course, at peak times, user demand might exceed 1,000Mbps, in which case, individual users would find that their internet goes slower than they expect. (For reference, a 10:1 ratio would actually be incredibly good; most ISPs typically commission about 1Mbps backhaul per broadband user).

The NBN required that the RSPs commission new backhaul, in the form of what is called a Connectivity Virtual Circuit or CVC. This had to be purchased from the NBN by the RSPs. And most didn't purchase large enough links to support their new NBN user bases and their higher-speed broadband. The upshot is that the contention ratio on these services is extremely high, so that during peak times, the network slows to a crawl. Netflix streams stall out, gaming pings go to hell and everybody gets grumpy.

The solution, of course, is for the RSPs to purchase larger CVCs. Presumably, most will do that over time, but right now, the rush to sign up users has led to some significant discounts on service

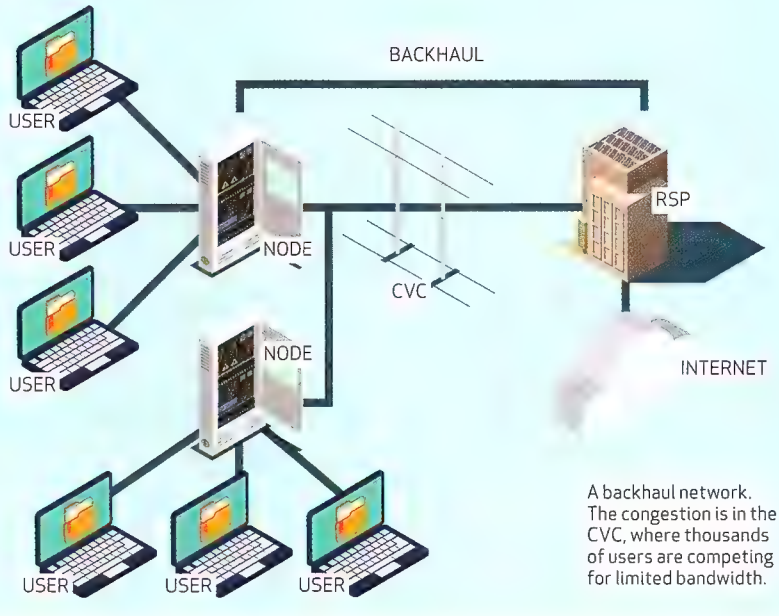


How the NBN explains the congestion.

costs, which means many RSPs feel like they can't afford to (and the cost of CVCs is currently a major bone of contention between RSPs and NBN Co).

The solution as a user is to avoid contracts and switch RSPs. If you're getting bad service, switch to another provider. It's simple as that. It's very easy on the NBN, since it require only that a virtual switch be thrown.

You can bounce around RSPs until you find one that delivers the service levels you want. ■



A backhaul network. The congestion is in the CVC, where thousands of users are competing for limited bandwidth.

Wired networking made easy

Joel Burgess tests powerline kits that'll put your home's powerpoints to work and give you the speed and stability of wired networking, without the need to lay cables.

A flaky internet connection when you're trying to stream TV, work remotely or be competitive in your favourite online game is an insufferable grievance for any techie.

But when it can cost over $200 per room (plus a callout fee) to get an electrician to install Ethernet ports around your house, getting a stable wired network connection set up will seem like an excessive luxury to many. But the alternative of turning your house into a cyberpunk film set by running fat blue Ethernet cables down the halls to eliminate all those Wi-Fi dead spots isn't ideal either. [*Hey, speak for yourself! — Ed*] Fortunately, there is a third option, where you don't have to pay through the nose for a professional connection or put up with residing in an Ethernet snake pit.

Powerline adapter kits (also commonly known as HomePlugs) are devices that plug into your home's power sockets and use the copper electrical cabling hidden in your walls to push an Ethernet signal from one socket-adapter to another. They generally do an excellent job of easily connecting any two power points — with the caveat being that they'll need to be on the same electrical circuit.

Some of the less-expensive models here come in at less than a quarter of the cost for an electrician, give reliable throughputs upwards of 20Mbps and are almost always simple plug and play solutions. If you want the reliability of an Ethernet connection without to much expense and hassle, powerline Ethernet adapters are an excellent networking solution.

BEST BUDGET KIT

$59 | WWW.TP-LINK.COM.AU

TP-Link TL-PA411KIT

A compact, no-fuss powerline adapter.

If you're looking to just push internet around the house, chances are you won't need more than an AV 500 Powerline adapter. Even NBN broadband speeds max out at 100Mbps — a figure well shy of the theoretical 500Mbps on offer here. In real-world testing, AV500 standard units come with Cat 5 Ethernet cables with max speeds of 100Mbps, but even with Cat 6 Gigabit Ethernet cables, AV 500 units won't get over 100Mbps in any practical test. The TL-PA411KIT is sometimes advertised as a 'Nano' starter kit as it's surprisingly compact for a Powerline adapter allowing a reasonable amount of plug types to slot in nicely beside it. This is fortunate as it doesn't have a power throughput socket so you will have to sacrifice the socket it slots into. Considering you can pick it up online for less than $60, it isn't a bad solution and though it'll push around 90Mbps between sockets at close range, it moves around 40Mbps through powerboards and at realistic usable distances over older cabling.

Verdict

Rather compact for a powerline adaptor and easy to use.

★★★★☆

BEST POWERLINE+WIRELESS KIT

$109 | WWW.TP-LINK.COM.AU

TP-Link TL-WPA4220KIT

A streamlined powerline kit with added Wi-Fi.

Since a powerline extension is already pushing Ethernet to a part of your house that the Wi-Fi isn't perfect in, it makes a lot of sense to tack on a Wi-Fi extender to the receiver plug. The extra wireless technology means makes it bulkier on the receiver side (the sending unit is a compact TL-PA411 unit), but even the Wi-Fi forwarding unit itself will allow another plug to fit in the socket next to it. The Ethernet connection is simply plug-and-play, but you'll have to edit the Wi-Fi name and password of the Wi-Fi forwarder and pair it with your router in order to use the Wi-Fi range extender. The TL-WPA4220 range extender is a little slower over distance than TP-Link's straight 500AV powerline adapter plug, with 88Mbps up and down over Ethernet at close range and 32Mbps download speeds over Ethernet in our Wi-Fi dead zone through older wiring. With two Ethernet out ports and Wi-Fi extension in the one system, it's actually really good value for the money.

Verdict

An affordable if slightly chunky solution to your Wi-Fi coverage woes.

★★★★☆

apc RECOMMENDS

BEST KIT AROUND $100

$109 | WWW.TP-LINK.COM.AU

TP-Link TL-PA7010PKIT

The best price on an midrange powerline Gigabit kit.

TP-Link's AV1000 Passthrough Powerline starter kit is another Gigabit powerline adapter set that comes with a socket so you won't have to sacrifice an entire double wall outlet at both ends. This new unit is even more square than its siblings and features a grilled basket top-half that allows for ventilation. Fortunatly, the unit has been designed to point up so it'll work well in any power outlets around the skirting board, but keep in mind that it is 12.6cm tall so it will be difficult to install underneath a benchtop or near the top of a cupboard. When you factor in that this unit offers an additional power socket and impressive throughput speeds, the price is impressively low. If you're thinking of patching an Ethernet connection further than a single room in a house with older wiring, we'd recommend spending a little extra for the TL-PA8010P KIT as it uses the active and ground lines to run two data streams for a more stable connection.

Verdict

If you have new wiring or don't need 80Mbps speeds, then this is a perfectly suitable option.

FASTEST POWERLINE KIT

$199 | WWW.DLINK.COM.AU

D-Link DHP-P701AV

Turn your powerpoints into full-throttle data points.

Since launching its initial range of powerline adapters, D-Link has gone back to each of its offerings and added a powerpoint passthrough version. While this is the most obvious alteration, the units themselves are actually totally reworked and notably faster than their non-passthrough counterparts. D-Link has trimmed off some of the DHP-701AV's width, not enough to keep it inside the midway point of your average power socket, but it'll allow smaller plug heads to slide in underneath it in adjacent slots. This surface area has been added to the total height of the unit, which points up with the Ethernet port at the top making it compatible with any low hanging powerpoint. Over the same long distance connection on old wiring, the P701AV performed around 30% faster than the 701AV and managed to knock some UPD signal loss off longer distance transmissions. Considering it'll cost you around $50 more than the DHP-701AV, it's good that it is a little faster otherwise it'd be a tad overpriced.

Verdict

While a bit pricey, it makes up for it with speed and convenience.

apc HOT PRODUCT

OVERALL EDITOR'S CHOICE

$140 | WWW.TP-LINK.COM.AU

TP-Link TL-PA8010PKIT

Supercharged wired-networking at the right price.

There's plenty to like about this kit. It features a Gigabit Ethernet connection and high-quality onboard processors that make one of the fastest powerline adapters available. Then there's the 2x2 MIMO data streams that help with connection stability over long distances and handle the demand from multiple users more effectively. The TL-PA8010P even adds extras like power pass-through sockets and a smart automatic power saving switch. All these features are available for a package that costs only $140, so it's difficult to not be enticed, but it's worth noting that this kit contains a couple of deal-breaking flaws for some. Most powerpoints are either below knee height or just above benches and desks, yet this adapter has been designed to splay down rather than up, with the Ethernet connection on the bottom making it impossible to use in the majority of household powerpoints. It's also a little too wide to fit anything beside it. Even with a cheap powerboard, this speedy kit is still the best value device you can get.

Verdict

While possessing some flaws, it's hard to deny the value this kit is offering.

OTHER POWERLINE KITS TESTED

$119 | WWW.DLINK.COM.AU

D-Link DHP-601AV

The DHP-601AV adapters are reasonably sized in the Gigabit category and though they do spill outside their dedicated slot space, many smaller plugs will fit in beside it regardless. These units punch above their price point at close range with maximum practical speeds clocked at 266.79 up 248.16 down, less than 20Mbps slower than D-Link's DHP-701AV. But this adapter doesn't include the MIMO streams of the priciest models that add stability over longer distances, so its downloads are around 87.59Mbps over longer distances.

Verdict

Without adding some of the features of the pricier models out there, this delivers great speed at a digestible price.

$129 | WWW.DLINK.COM.AU

D-Link DHP-701AV

Forget any plans to plug something in next to one of the 701AV adapters, as they protrude almost to the centrepoint of the adjacent sockets. Bigger processors for faster throughput, Multiple Input Multiple Output (MIMO) networking capacities and the ability to connect up to 16 adapters on the same powerline are responsible for the increased footprint. At close range the 701AV's speeds were similar to the less expensive DHP-601AV, but over a longer connection it maintained download speeds of over 100Mbps at all times.

Verdict

This unit will dominate your power socket space, but with the power and capacity to make it worth it.

$149 | WWW.DLINK.COM.AU

D-Link DHP-W313AV

The Wi-Fi repeater half of D-Link's DHP-W313AV is large in all the wrong places, eclipsing any adjacent sockets. Its peak performance over a short distance was worse than TP-Link's TL-WPA4220KIT, netting an Ethernet download speed of only 67.48Mbps. However, its transmission across older wiring was more in line with expectations, with speeds of between 20 and 40Mbps. The DHP-W313AV does have 5 and 2.4 GHz Wi-Fi bands, so it'll be better than the TL-WPA4220KIT if you just want it for Wi-Fi.

Verdict

You'll want to dedicate a whole socket to this fatty. It's got what you need, if you just need Wi-Fi.

TEST RESULTS: POWERLINE NETWORKING KITS

	TL-WPA4220KIT	DHP-W313AV	NP508	TL-PA411KIT	TL-PA4016PKIT	NP511
CATEGORY	WIRELESS	WIRELESS	WIRELESS	VALUE	VALUE	VALUE
SCORE*	4	3	3.5	4	3.5	3
PRICE	$99	$149	NA	$59	$72	$90
DIMENSIONS (CM)	9.4 x 5.4 x 4.0	10.1 x 7 x 4.5	11.6 x 6.2 x 4.2	6.5 x 5.2 x 2.9	6.5 x 5.2 x 2.9	11.2 x 5.6 x 4.7
UP TCP (MBPS)	88.21	67.48	90.7	90.27	89.88	90.03
DOWN TCP (MBPS)	89	56.44	91.18	90.41	90.48	91.1
UP UDP (MBPS)	NA	NA	NA	NA	NA	NA
DOWN UDP (MBPS)	NA	NA	NA	NA	NA	NA
SIGNAL LOSS UP (%)	NA	NA	NA	NA	NA	NA
SIGNAL LOSS DOWN (%)	NA	NA	NA	NA	NA	NA
(LONG) UP TCP (MBPS)	27.29	21.67	48.97	32.56	52.68	45.37
(LONG) DOWN TCP (MBPS)	31.82	39.26	54.06	44.28	67.94	70
(LONG) UP UDP (MBPS)	NA	NA	NA	NA	NA	NA
(LONG) DOWN UDP (MBPS)	NA	NA	NA	NA	NA	NA
(LONG) SIGNAL LOSS UP (%)	NA	NA	NA	NA	NA	NA
(LONG) SIGNAL LOSS DOWN (%)	NA	NA	NA	NA	NA	NA

NOTE ** TEST SCENARIO #2

$72 | WWW.TP-LINK.COM.AU

TP-Link TL-PA4016PKIT

We understand, in theory, why TP-Link made an AC passthrough version of its AV500 Powerline Adapter, but this kit manages to cancel out the benefit of power passthrough by being big enough to eclipse additional adjacent sockets. The bigger AC passthrough unit doesn't see any speed increases from the standard TL-PA411 KIT in close range tests, but shows greater stability and speed at a distance over old wiring with download speeds of 90.48Mbps and 67.94Mbps, respectively.

Verdict

Again, the size of this unit is going to be an issue, but if you want stability, this is an option to consider.

$195 | WWW.NETCOMMWIRELESS.COM

Netcomm NP507

It isn't quite as possessive over neighbouring sockets as the the DHP-701AV units, but the NP507 is still one of the largest powerline adapters we've seen. Much like the other Gigabit adapters, Netcomm has dropped the second Ethernet port from its NP705, and though it gets data transfer speeds of 120Mbps over a short distance, this drops to 56.8Mbps down and 43.16 up over longer distances. It's not the fastest, but it does offer a bandwidth that will appeal to many and plays nice with most powerpoints.

Verdict

Better up close and personal than far away, but at least you can use both sockets.

HOW WE TESTED

In the past, we've tested the speeds through a new house with pristine wiring, and although this situation allows the devices to be pushed to their limits, it's unlikely to be the typical usage case. In light of this, we tested on what we believe will be a typical setup: older electricity wiring in an existing building, including the use of powerboards. Powerline manufacturers recommend you don't use powerboards, as some surge protection mechanisms impede data transfer, but for the most part, they're fine and save you from eclipsing an entire powerpoint.

	DHP-601AV	NP507	TL-PA7010P KIT	DHP-701AV	TL-PA8010P KIT	DHP-P701AV
CATEGORY	GIGABIT	GIGABIT	GIGABIT	MIMO	MIMO	MIMO
SCORE	4.5	3	4	4	4.5	3.5
PRICE	$119	$89	$99	$149	$125	$199
DIMENSIONS (CM)	8.7 x 6.2 x 3	11.6 x 6.2 x 4.6	12.6 x 7 x 4.2	9.8 x 7.3 x 3.4	13.1 x 7.2 x 4.2	11.9 x 6 x 3.7
UP TCP (MBPS)	248.16**	123.04	235.2**	317.4**	288	281.9**
DOWN TCP (MBPS)	266.79**	146.19	327.4**	261**	300	326.5**
UP UDP (MBPS)	295.5	NA	343.1	369.6	NA	313.4
DOWN UDP (MBPS)	226	NA	244.9	282	NA	295.5
SIGNAL LOSS UP (%)	0.80%	NA	0	4.20%	NA	11.70%
SIGNAL LOSS DOWN (%)	1.40%	NA	1.30%	1.40%	NA	1.40%
(LONG) UP TCP (MBPS)	69.81**	43.16	88.5**	81.3**	93.87	90.2**
(LONG) DOWN TCP (MBPS)	73.21**	56.8	118.8**	92.73**	123.76	125.4**
(LONG) UP UDP (MBPS)	26	NA	92.7	65.27	NA	88.7
(LONG) DOWN UDP (MBPS)	75.75	NA	128.8	101.17	NA	131
(LONG) SIGNAL LOSS UP (%)	0%	NA	0.60%	26%	NA	11.50%
(LONG) SIGNAL LOSS DOWN (%)	0%	NA	2.60%	1.90%	NA	3.10%

NOTE ** TEST SCENARIO #2

HOW TO MINE BITCOIN

Turn your PC into a mining machine with Alan Dexter & Nate Drake.

Mining is the process of using a computer to perform complex calculations on blocks of data which maintain the Bitcoin network. Miners are rewarded for their efforts with a certain amount of Bitcoins.

Bitcoin (BTC) is fast becoming the province of people using specialised ASIC (application-specific integrated circuit) devices, although if you have one or more powerful graphics cards, you may be able to make a small profit by building your own mining device. You'll learn more about this in the following steps.

Any profit you make will depend on a number of factors. The first is your 'hash rate' or the actual processing power of your PC. Computers designed for mining, or 'rigs' as they're commonly known, require large amounts of electricity, which will increase running costs. The complexity of mining also rises over time.

The Bitcoin itself is a very volatile virtual currency, and while it has recently made huge gains, it also lost more than half of those – and with very little notice. Bear this in mind if you plan to hold onto any BTC you mine, rather than selling immediately. If you want a rough idea of how much you can make from mining, use one of the many online profitability calculators; for example, the one at **99bitcoins.com**.

While you can technically try to mine Bitcoin on your own, it's very unlikely that your rig will single-handedly solve the complex sums necessary to receive a reward. Instead, you'll need to join a mining pool. As the name suggests, this is a pool of multiple machines connected together, engaged in a collaborative mining effort. Any Bitcoin rewards that are reaped are shared amongst everyone who contributed processing power to the mining effort.

However, note that the way in which profits are shared can vary from pool to pool. You can learn more about pooled mining at **en.bitcoin.it/wiki**

1 CHOOSE YOUR MINER

One easy — but not cheap — way to get started with Bitcoin mining is to buy an ASIC device, such as the AntMiner S9. These devices have been specifically designed for mining Bitcoins which means they'll generally give you the greatest return on your investment.

However, as mentioned, these ASIC devices are expensive. The S9, for instance, currently retails for US$2,400. You will usually need to buy a separate power supply unit which will set you back something like another US$350. These devices are usually designed specifically to mine Bitcoin and will not function well if you try to use them to mine other cryptocurrencies (if, say, Bitcoin should happen to fall drastically in value).

Alternatively, you can build your own Bitcoin mining rig. While these aren't as efficient in terms of power and hash rate, they require less upfront expense and can mine other currencies besides BTC. In the simplest terms, these are computers with multiple powerful graphics cards installed. These GPUs might be primarily designed to render complex graphics when playing games, but they also lend themselves well to coping with the complex calculations involved in Bitcoin mining.

To get started, you'll need to purchase a case for the machine. Most of these are a simple metal frame to allow heat to dissipate easily. You'll then need to choose a motherboard and graphics cards for mining, such as the AMD Radeon RX 580.

If you need some more advice, see our guides on choosing the best graphics cards (**bit.ly/2DE4sOt**) and motherboards (**bit.ly/2D8eC94**) for mining. You'll need to assemble the machine and install the OS and mining software yourself, so you should only go down this route if you are tech-savvy and familiar with computers.

If neither of these options appeals to you, you can rent hash power from cloud mining companies. These firms have dedicated data centres devoted to mining Bitcoins. As they are centralised, they can buy machines in bulk and use efficient methods to generate electricity.

Most companies will offer you a fixed amount of Gigahash Seconds (GH/s) of mining power for a fee. The advantage is that you don't need to buy any hardware. The fees for cloud mining will vary, however, and another point to be wary of is scammers posing as cloud mining outfits. See the Bitcoin Wiki for reputable vendors.

2 SET UP YOUR BITCOIN WALLET

Once you've decided that mining is right for you, you'll also need to set up a Bitcoin wallet to store your profits. If you're mining as an investment and don't plan on spending any of your coins soon, consider using a website such as **bitcoinpaperwallet.com** to create a 'paper' wallet. Make a note of the 'public' address, which you can use to receive payments.

You can check the balance of your wallet at any time by visiting **blockchain.info** and entering your payment address into the search bar at the top-right. Don't let anyone see your private keys as anyone with access to your paper wallet can control your Bitcoins.

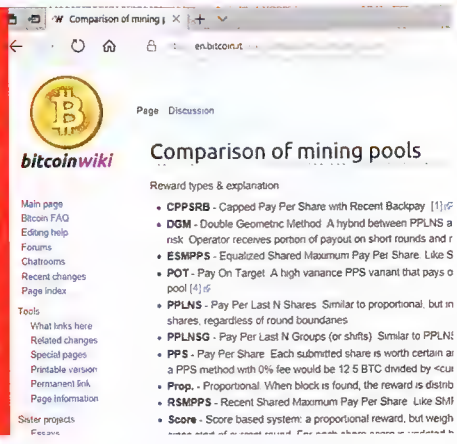
If you plan to regularly cash out your BTC or make payments, consider using a software wallet. The Electrum wallet (**electrum.org**) is available for all major desktop operating systems and Android. When you create your wallet, Electrum will generate a 'seed' of a dozen random words to use as a private key. This enables you to restore your wallet if anything happens to your PC.

If you use a software wallet, try to do it on a machine that isn't connected to the internet so your BTC can't be hacked. This is known as 'cold storage'. The Electrum website has instructions for setting up a 'watching' wallet for day-to-day use which can show your balance but cannot make payments itself. For full instructions on setting up secure offline storage, see **bit.ly/2Dxa3WC**.

3 PICK A BITCOIN MINING POOL

The next stage is to sign up to a pool; you can solo mine, but you need some serious hardware to make it worthwhile. You can find a list of pools on the Bitcoin wiki.

We'll walk you through the process of signing up for Slush Pool (**slushpool.com**) because it's one we've used a lot, but the same procedure can be used for any of the major mining pools.

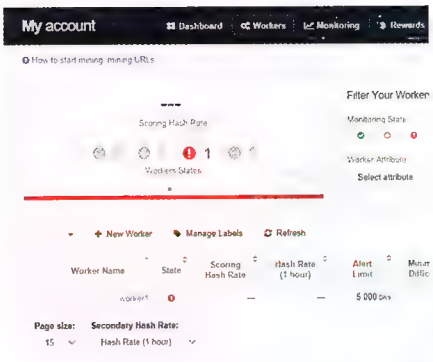


Settings at the top-right, then clicking Bitcoin on the left. Choose Payouts, then click the New Wallet button. Paste in your public address for Bitcoin payouts here. If you're using a paper wallet, this should be clearly marked. In Electrum, you can view your current receiving address by clicking on the Receive tab. Click Submit when you're done.

Some miners also enable you to choose the payout threshold – in other words: how many BTC you need to have mined before the Pool sends funds to your wallet. This is important, as while it's risky to leave large amounts of BTC in an online wallet, transaction fees for sending BTC across the network are currently very high, so you could end up paying a lot for multiple smaller payments. Choose freely and wisely.

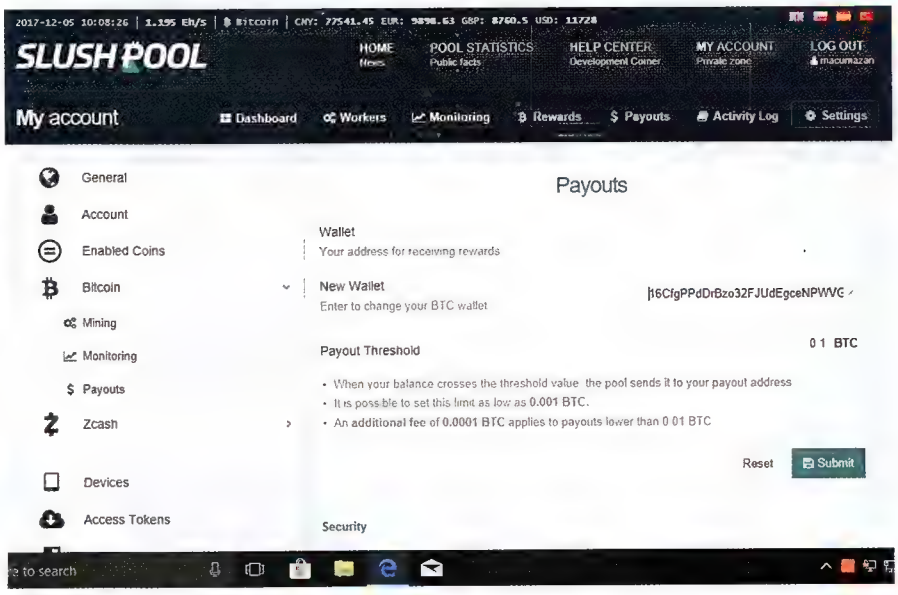
4 JUMP IN

Head to the Slush Pool website and click 'Sign up here'. On the registration page, choose a username, then enter your email address and password. You will be sent a confirmation email. Click the link to validate your email address. You'll see that a 'worker' has been created for you, so you can begin mining. You should ideally have one worker per device. You can visit the Slush Pool site at any time to view and create workers.



5 FUNDED MINING

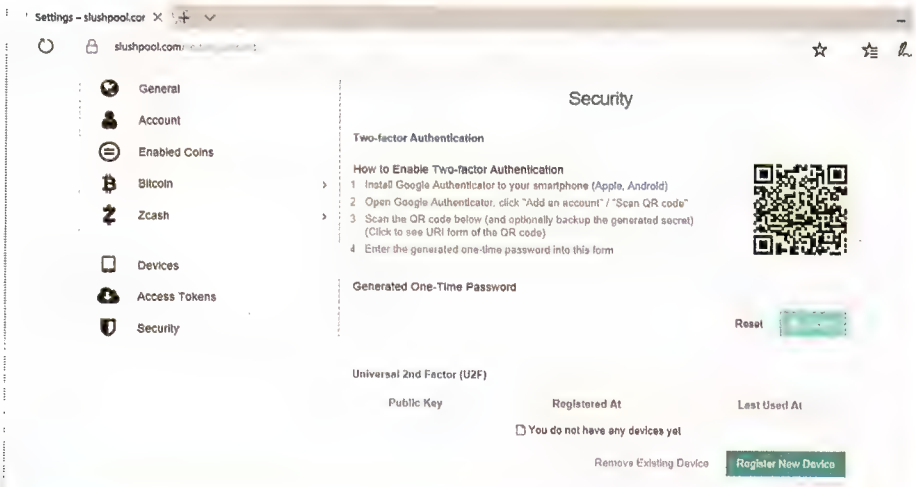
You need to tell your mining pool where and when to send the funds from your mining exploits. On the Slush Pool website, you can do this by clicking



6 POOL SAFETY

Mining pools are a popular target for hackers for obvious reasons. To make sure no one can potentially pilfer your Bitcoins, first check that your pool uses SSL. This means your connection is secure – in most web browsers, you'll see a padlock icon (in the address bar) if this is the case.

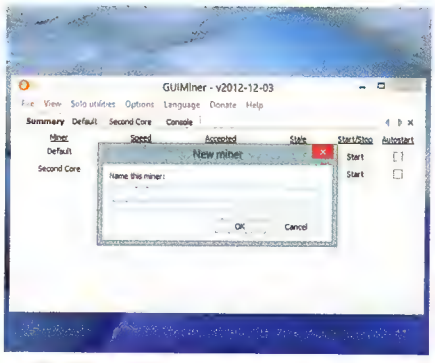
Certain mining pools, such as Slush Pool, also enable you to secure access to your account by using two-factor authentication. This introduces a second step for a successful login and is, therefore, another hurdle to prevent hackers from breaking into your account. To use this, you'll need access to a mobile device and an app such as Google Authenticator or Free OTP.



7 GRAB BITCOIN MINING SOFTWARE

Now you need to download the mining software to your PC. You have a few options here, but to get started, we'd recommend using GUIMiner (**guiminer.org**), if only because it has a straightforward interface.

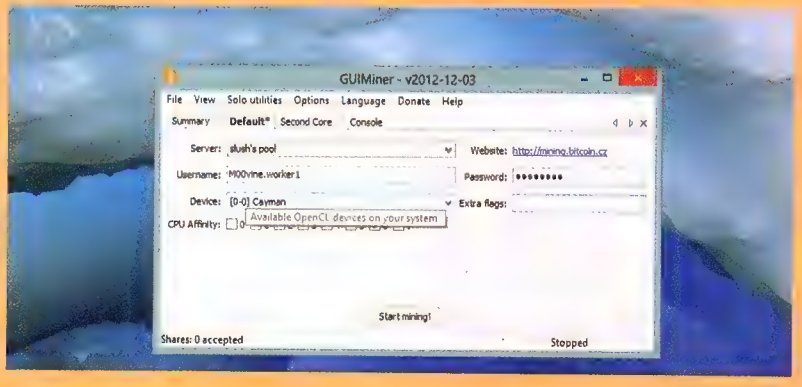
It comes as a self-extracting archive and runs straight from the folder to which it's extracted.

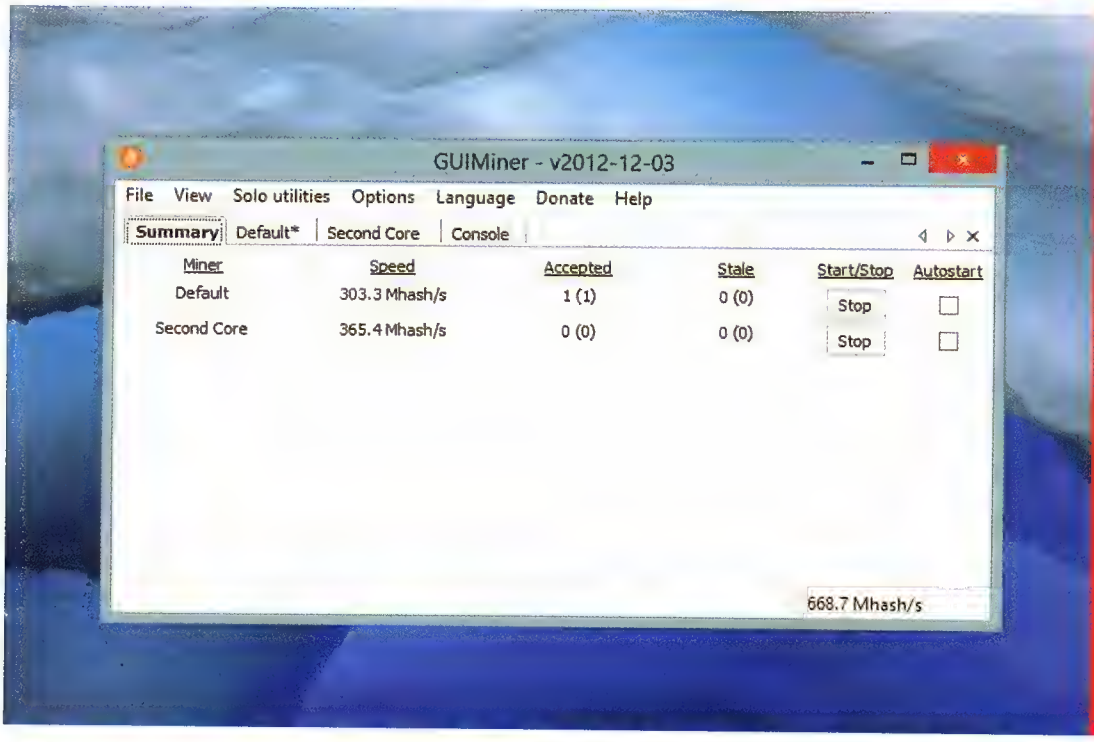


8 CONFIGURE MINING

Launch GUIMiner and select 'Slush's pool' from the Server menu. Type in the name of the worker that was created when you registered your account — it'll be [username].worker1 — and enter the password for the worker.

Select your graphics card from the Device menu and then click the 'Start mining' button to get going.




GUIMiner - v2012-12-03
File View Solo utilities Options Language Donate Help
Summary Default* Second Core Console
Miner Speed Accepted Stale Start/Stop Autostart
Default 303.3 Mhash/s 1 (1) 0 (0) Stop
Second Core 365.4 Mhash/s 0 (0) 0 (0) Stop
668.7 Mhash/s

9 VIEW YOUR PROGRESS

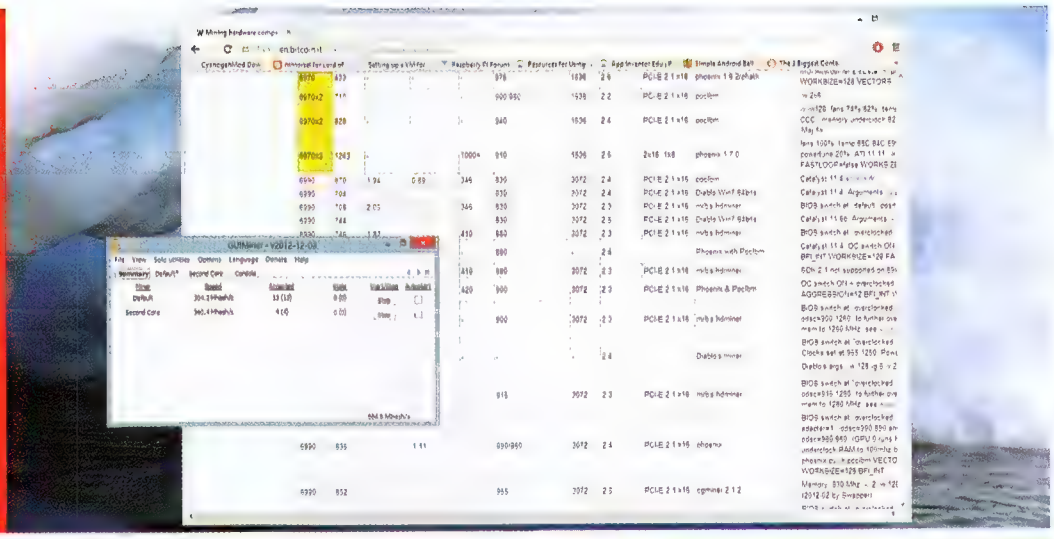
GUIMiner should now communicate with the servers to get shares for your machine to work with. You'll see your hash rate at the bottom right and the current state of your work in the bottom bar.

You can also see the console (useful if you have connection problems) or a summary page (great if you have multiple cards) via the View menu.

10 TIME TO OPTIMISE

If you're running a mining rig instead of specialised hardware, you can make a few tweaks to make sure it's running at peak efficiency.

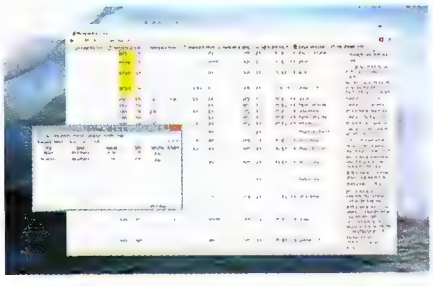
To do that, do a quick search to see what the recommend flags are for your graphics card by heading to the Mining hardware comparison page at **bit.ly/2DayCro**

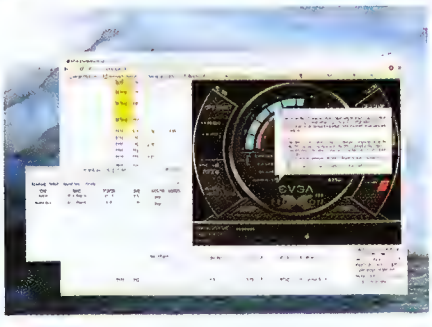


11 DATA MINING

The information you want from this table is under the Notes column. This is where you'll find the switches that push your graphics card that little bit harder, making them better at Bitcoin mining.

The important ones are those relating to the workload (-w) and whether to use vectors (-v). Enter these values into the Extra Flags block in GUIMiner, stop mining and then restart it.





12 PRECISION TUNING

This should give your Bitcoin mining PC's performance a nice boost, but to really get the most from your card, you need to turn your hand to a little overclocking.

We recommend grabbing EVGA's Precision X utility (**www.evga.com/precisionx**), although you can get quite far using the overclocking tools that are part of AMD's Catalyst drivers.

13 BEAT THE HEAT

Whether you're using a specialised ASIC Miner or your own rig, the device is going to run very hot when trying to mine BTC. Therefore, be sure to place your mining hardware somewhere with good ventilation so the heat can dissipate easily. Generally speaking, the cooler your mining machine, the more efficiently it will perform. Be sure to factor in the cost of air conditioning and/or a heat pump into your mining calculations to be certain you're still running a profitable enterprise.

If you live somewhere cold, you could follow in the footsteps of smart Siberians and use the excess heat from mining as a 'data furnace' to heat your home.

14 KEEP MINING PROFITABLE

As research continues into specialist mining equipment and the difficulty of mining increases, the highest profits from mining are usually earned by data centres based in locations where energy is cheap, such as China. As a hobbyist miner, you can maximise your profits by following their example by using ASIC miners and keeping electricity costs down.

You can increase the efficiency of your rig by using an efficient PC power supply (PSU). You can get help with this in the Pools section of the BitcoinTalk forums (**bitcointalk.org**).

An alternative way to get one over on the 'big bully' miners is to use renewable energy to power your mining machine — for example, by installing solar panels on your property.

If you do this, remember that the advertised wattage for devices is usually the optimal amount you'll receive under ideal conditions. Solar panels in particular are affected not just by the amount of sunlight they receive, but by surface area, the angle at which they're placed, and the direction in which they're facing. Speak to a qualified installer, fully explain your needs, and get things right.

To get started, consider using an electricity usage monitor to measure the energy consumption of your mining device in kWh (kilowatt hours). These are very inexpensive and are available from any hardware store.

Remember that the reward for mining Bitcoin halves every 210,000 blocks. You can find a more detailed explanation of this on the Bitcoin Wiki, but essentially, this means mining becomes less profitable over time, unless you can increase your hash rate — or the value of Bitcoin increases.

STREAMLINE YOUR WINDOWS 10 INSTALL

Alex Cox shows you how to cut out everything you don't need, and create a custom Windows install for next time.

Bloat is the curse of operating systems, because they need to appeal to the masses, rather than cater for individuals. You can't have a Microsoft engineer sit there and craft you your own custom version of Windows (we know, we've asked), so you need to scrape off that additional chaff yourself. We're not just talking about shaving away the contents of a couple of megabytes of storage space, or cleaning up the Start menu. Windows comes with stacks of software that can reduce your machine's performance or boot time. It comes with stuff that can see what you're doing. It includes features that are potentially monumentally annoying. So we'll do away with all of them, and explain what's safe to chop, and what isn't.

Doing all this work every time you get a new PC would be very frustrating, so we're also going to look at creating an already-mostly-trimmed Windows installer, which you can use to start from a much more advanced point than usual, and even integrate apps that make up for some of Windows 10's shortfalls. A better Windows for your PC of tomorrow.

Windows doesn't seem to encourage trimming, but a little knowledge goes a long way. Our sacrificial OS for this guide is the latest official ISO of Windows 10 Home, updated for the Creators Update, because (presumably) that's the version most people are using; if you're taking a hammer to the Pro version, you might have to tease out a few more services, but the changes won't be too extreme.

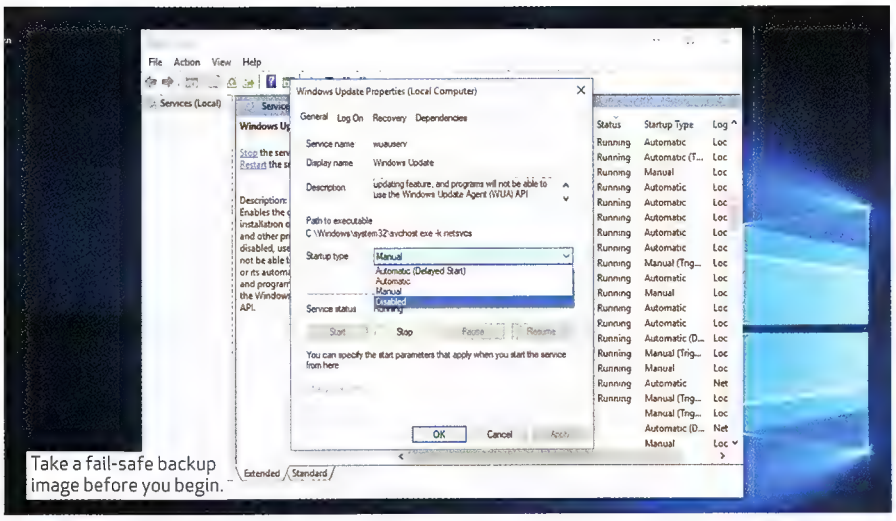
"Windows doesn't seem to encourage trimming, but a little knowledge goes a long way. Our sacrificial OS for this guide is the latest official ISO of Windows 10 Home, updated for the Creators Update."

INTERFACE OVERHAUL

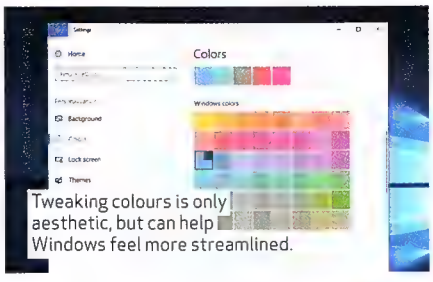
Although Windows 10's interface is already a highly streamlined affair compared to its predecessor, it could stand to be slicker. Let's begin, with our clean Windows install, by making it snappier, removing unnecessary elements, and making that experience all the better. What better place to start than, well, Start itself? While we personally love the Start menu tiles, you may not be such a big fan.

Windows 10 Pro includes tools such as the Group Policy Editor, which can help you do away with them quickly, but in Windows 10 Home, you're stuck with the tedious process of right-clicking each tile, and selecting 'Unpin from start'. Do this enough times, click off the Start menu, and relaunch it, and that right side panel disappears altogether. Clearing out the main bulk of the menu itself, apart from a certain selection of Windows' default apps, is again a case of wading in with right-clicks, and uninstalling. Those apps that simply won't uninstall – the monsters – can usually be excised using Powershell. See the 'Ultimate removal' boxout (page 74) to find out how to remove and, if you're desperate, reinstate them.

There is a host of surface personalisation tweaks that you can apply to the Start menu and Taskbar through the 'Settings › Personalisation' menu. You can change the colour by first selecting an accent colour in Colours, then checking the box to apply it to the Start menu, Action Centre and Taskbar. While you're on the same screen, switch off transparency effects for a microscopic performance boost, then head to the Start tab. Because we're old school, we favour switching off everything here to make the Start menu a straight alphabetised list of



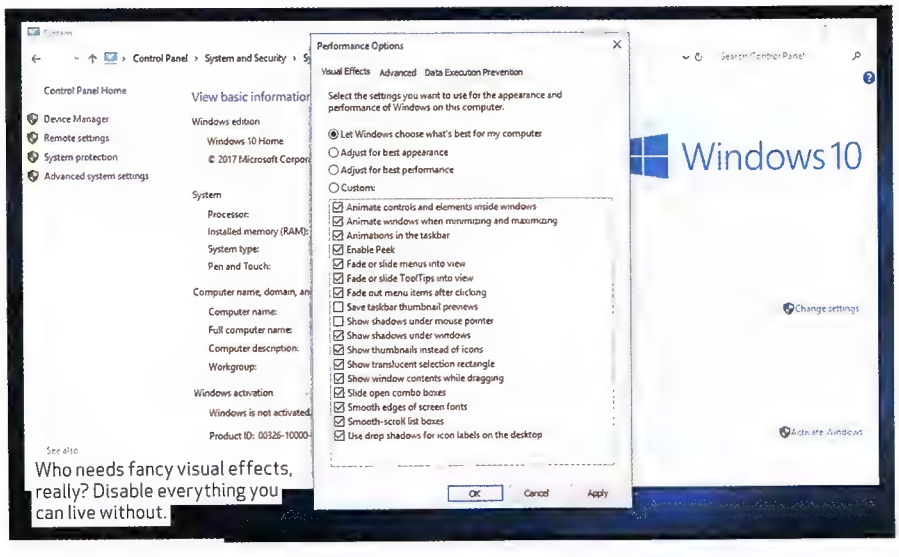
Take a fail-safe backup image before you begin.



Tweaking colours is only aesthetic, but can help Windows feel more streamlined.

apps, but we're not going to say you're wrong if you like having recently used or installed apps pushed to the top. Suggested apps, though? That can definitely go. At the bottom of the page, click 'Choose which folders appear on Start' to get quick links to a bunch of useful features on there. Quite why File Explorer and its ilk aren't included by default, though, is baffling.

Basic stuff done, let's do some more intricate tweaking. Open up 'Control Panel › System and Security › System › Advanced system settings', then click the Advanced tab. Jump into the performance settings, and switch off everything you can't stand to lose. Since we're currently here for efficiency, not looks, we recommend disabling animations, fades, shadows – basically, everything bar font smoothing. Save your changes, then open up the Registry editor for a quick deeper hack. Navigate to the 'HKEY_CURRENT_USER\Control Panel\Desktop' key, open up the 'MenuShowDelay' entry and change its value. A flat zero tends to make things a little overcrisp – read: impossible to use – but halving the number can really make Windows feel a lot more responsive.



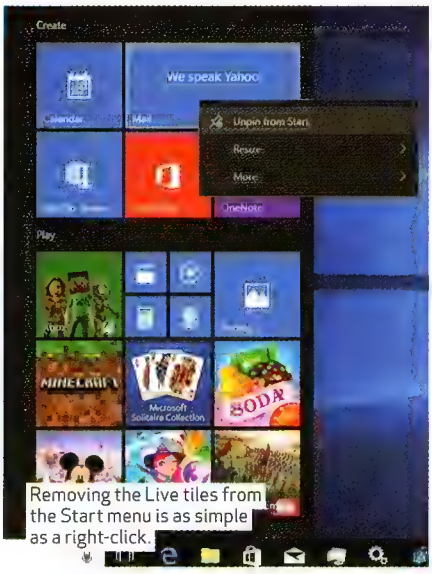
Who needs fancy visual effects, really? Disable everything you can live without.

BACK TO BASICS

Now head back to the control panel, because it's time to do a little old-school scrubbing. Head to 'Programs › Programs and Features' and select 'Turn Windows features on or off'. The list isn't over-extensive, and there's not much you can remove that will leave you with a faster PC, but it can prevent some annoyances. Drop, for example, Internet Explorer 11, because you don't use it, and there's no sense keeping it around. You can also kill off Windows Media Player, if that's not your jam.

Next, let's improve your boot speed by preventing a few things from running at startup. Launch the Task Manager with 'Ctrl-Shift-Esc' and head to the Startup tab. Each program that's launched automatically is listed with a broad rating of its start time impact. If there are components you use very little, it's a good idea to stop them; to squash OneDrive's system-grinding initial launch time, for example, right-click it, and set its status to Disabled. For more intricate control, Microsoft's Sysinternals team has long published Autoruns (**bit.ly/2CKVQo5**), a free – and portable – add-on that offers access to the same management tools as Task Manager, plus a lot more.

More classic cleaning can be done within Windows 10's Settings screen. Microsoft's love for its Universal apps



Removing the Live tiles from the Start menu is as simple as a right-click.

means it presumes you'll want to use them, and are going to want them ready at a moment's notice, running in the background at all times. Which may be true, but disabling those background apps is preferable if you want a smoother-running PC. In 'Privacy › Background Apps', you can switch off anything you're happy to just fire off manually, which will likely include, well, just about everything.

One more quick optimisation, whether you're running a small drive or not, would be to clean up temporary files, and wash away old versions of Windows. This will gain a fraction more speed in certain apps if they're forced to grind through cache directories before running, but you're not doing this just for speed; you're doing it for cleanliness. Find the drive you want to optimise in File Explorer, right-click it and select Properties, then seek out Disk Cleanup in the General tab. Select the categories that you want to kill off, and then use 'Clean up system files' to expunge the lot.

SLASHING SERVICES

We are, of course, working on a clean Windows install, but you probably aren't. Disabling the core Windows services – those programs that run quietly in the background, supplying your PC with essential (and inessential) functions that don't require an interface – isn't necessarily recommended; Microsoft's own suite has been honed over the years to be as efficient as possible, its contents sitting in the pagefile, barely ever touching system RAM. You could chop out most Windows services and never feel a difference on a modern machine, apart from the whole operating system crumbling around your ears. Third-party services, though, are a different story, and cutting them out means you're likely to see a real change, which (usually) will only impact that app's time to initial launch.

First up, find out what's running. The Task Manager is a good place to start. Switch to the Advanced view, and scroll down to see the entries prefixed with the words 'service host'. These are all fired off via svchost.exe, so they're categorised together. Some might contain more than one service, which you can discover by clicking the expand arrow on the left; and most, while not essential, are there to improve your Windows experience. A quick glance through the list in our clean install reveals Superfetch as the main culprit for RAM hogging – as it should be, given that it's the service that puts commonly accessed data into RAM, rather than spending ages reading it from the hard drive. Our biggest CPU sapper is the usefully named Local System, which deals with Windows updates. That's the perfect target for now: We know there are no updates pending, so we can stop it.

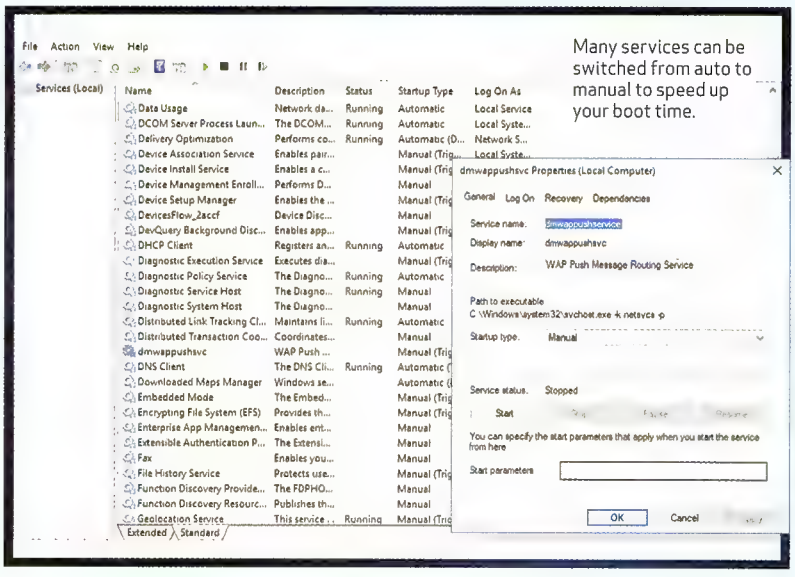
Clumsily ending the task in Task Manager won't do. Instead, type `services` into the search bar to open the services section of Windows' Management Console. You won't find Local System in the list, but you should find the two components we're looking for: Windows Update and the Update Orchestrator service. Right-click them, select Stop, and they'll go away until your next boot. Those sanctions not

Safe services

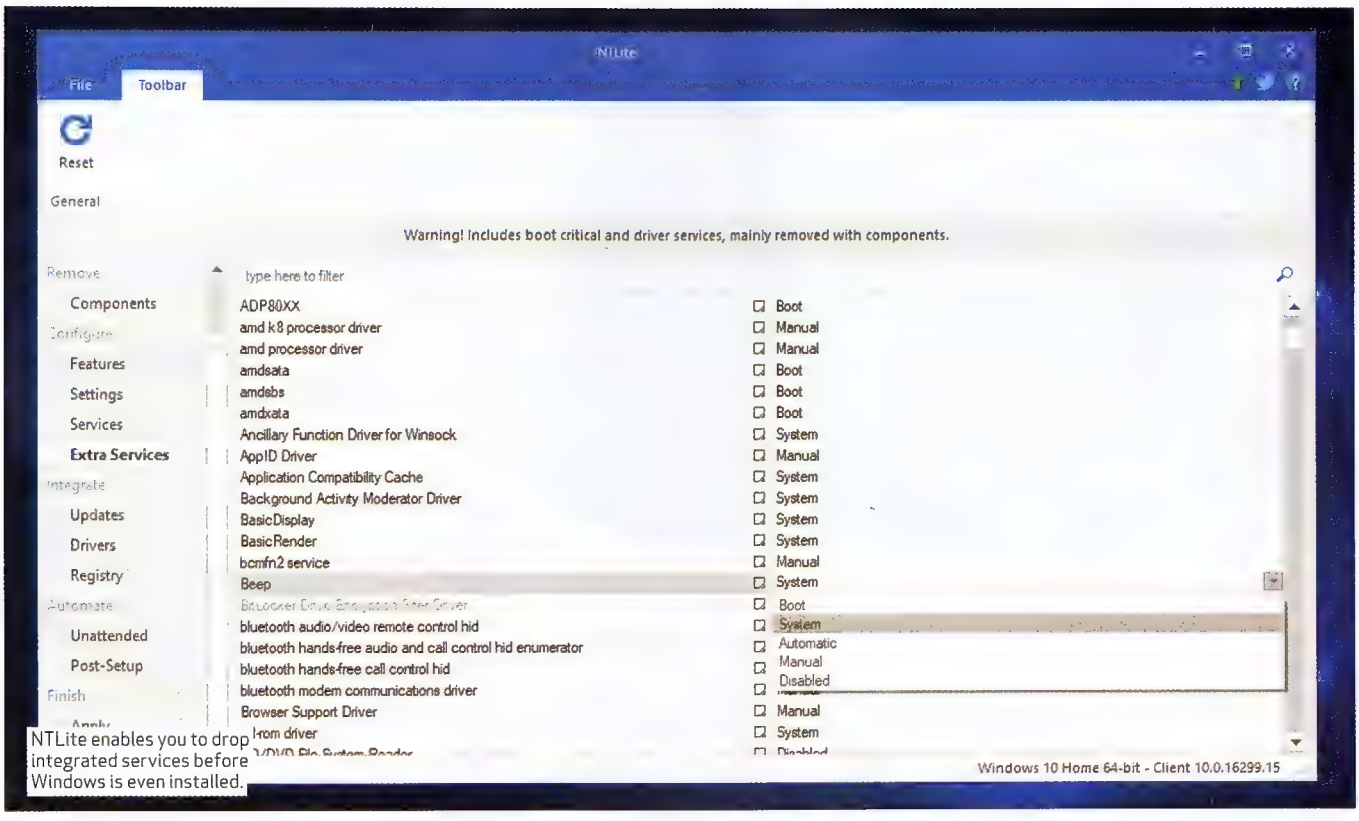
There's a laundry list of services that can safely be switched from automatic to manual for a boost at boot time; disabling them altogether is a question of your preferences, or Windows' ability to hold up. Cut Connected User Services and Telemetry, dmwappushsvc and Diagnostic Tracking Service to remove Windows' spying — uh, telemetry — tendencies, then Diagnostic Policy Service, Windows Error Reporting Service and Program Compatibility Assistance Service to do away with a few services that you won't want bothering you once you've started using Windows in earnest. You can also disable Remote Registry just to be a little secure, and Windows Defender Service — and possibly Security Centre — if you're confident in your own malware-fighting methods.

A lot of the other possibilities will depend on the specific makeup of your machine. Shut down IP Helper if you're not using IPv6, TCP/IP NetBIOS Helper if you're not part of a workgroup, or Distributed Link Tracking Client if your PC is not on a network at all. Kill Print Spooler if you don't have a printer, Windows Image Acquisition (WIA) if you don't have a scanner, Touch Keyboard and Handwriting Panel Service if you don't have a touchscreen, Bluetooth Support if you haven't already got the idea here, and Downloaded Maps Manager if you never use Windows 10's built-in maps app.

You may also wish to make a few other services manual, without disabling them. The three remote desktop services are optional, and your graphics card — or possibly sound driver — has likely slipped a few in. Dropping these to manual will improve boot time, but probably slow the launch of your graphics-intensive apps. That's a common theme with services: Unless you completely disable them, you simply delay the, uh, delay... and disabling is rarely the best idea. But do experiment, and see what works for you.



Many services can be switched from auto to manual to speed up your boot time.



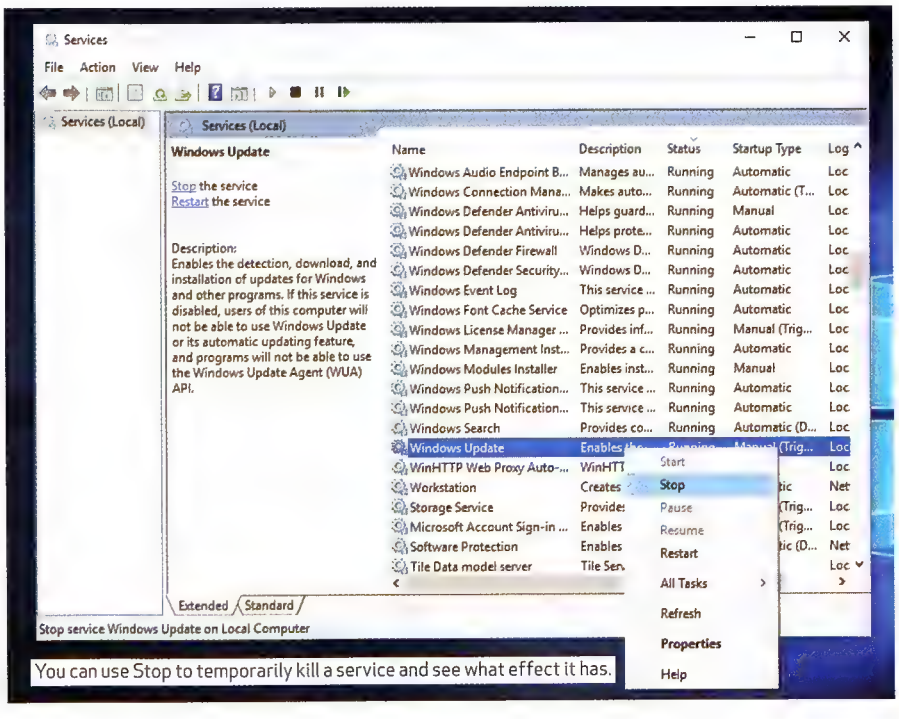
NTLite enables you to drop integrated services before Windows is even installed.

harsh enough? Right-click, select Properties, and poke around the General tab. Change the 'Startup type' to Disabled, and they won't come back until you dig through the list and switch them back on again. Be warned, though: Unless Windows is happy to do without, this a stupid thing to do. Even more stupid – but similarly possible – would be to remove a Windows service altogether, although cutting out a third-party service, maybe even a piece of malware, is unlikely to sting too much. Run the Registry editor by typing `regedit` into the search bar, then dig down to 'HKEY_LOCAL_MACHINE/SYSTEM/CurrentControlSet/Services'. Finding the particular service you want to kill can be tricky, but click around until you find it, then rename (or, eek, delete) its key to get rid.

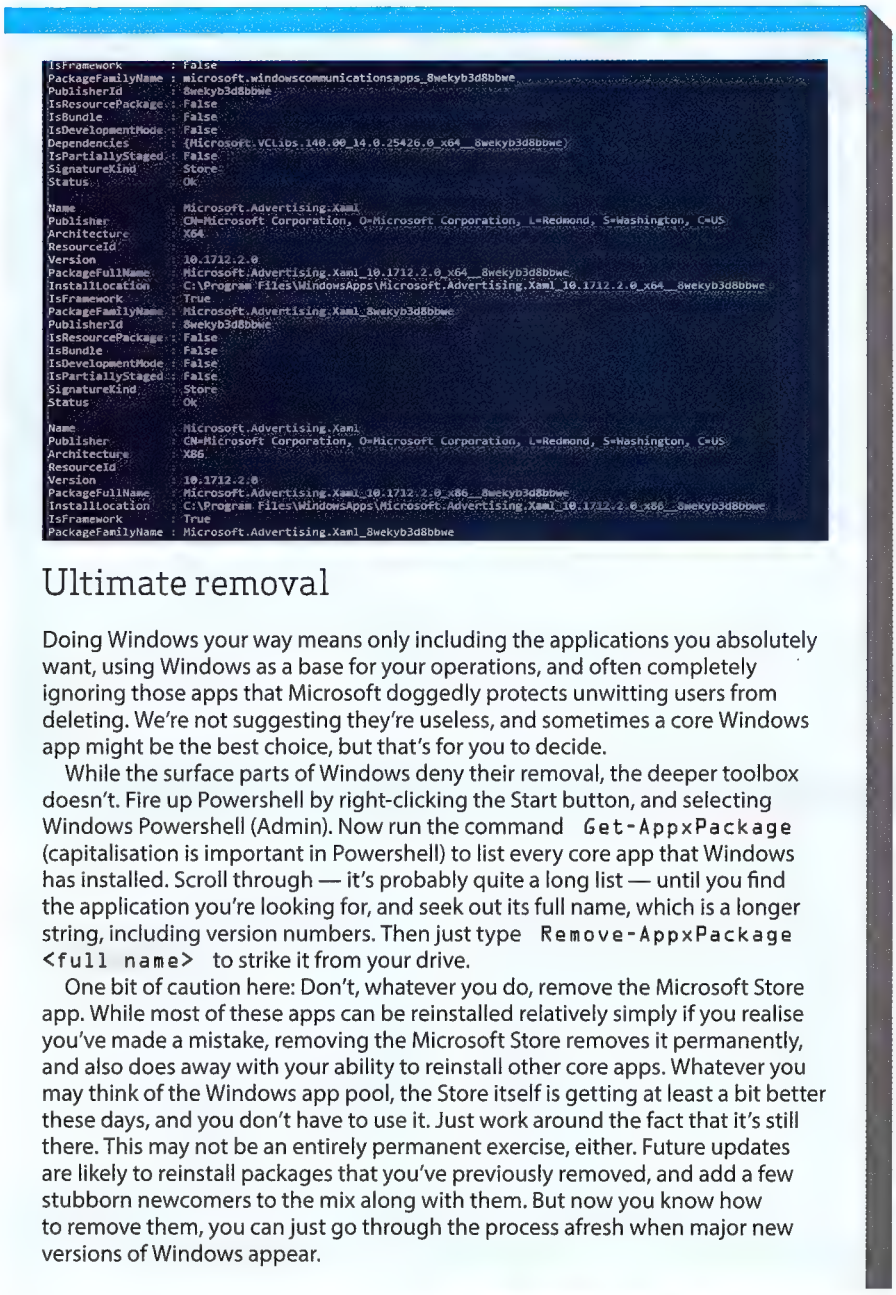
BACK IN TIME

If you're installing on a new machine, there's no reason you have to use Microsoft's stock ISO. Installation customisation tool NTLite actually makes generating a stripped-down Windows easier, and it means you can arguably do a lot more in a lot less time. It's also a chance to save a bunch of time post-install, as you can integrate all the drivers, updates and software you need into your custom installer, so it's there straight away. What's more, it's a fantastic way of cutting down an existing Windows installation, as long as you pay for a licence – although you'll only be able to create your own install image if you're chipping away at an ISO, rather than a running system.

Let's concentrate on trimming a new ISO – the live process is no different, just a little more narrow. Download the software from **www.ntlite.com** via the three-line 'hamburger' menu, and run through its installer – you can also create a portable version of NTLite at this point by checking the appropriate box, so you can drop it on a USB flash drive, and take it from PC to PC if necessary. Before you run it, mount your Windows ISO (you can download one from the Microsoft website, if you don't have one handy) by right-clicking the file, and selecting Mount, then copy over the files to a writable folder to prepare them before unmounting again. Open NTLite, click the Add button on the ribbon, and point it at the folder where you dropped your installer files. Pick the version of Windows you're looking to hack,



You can use Stop to temporarily kill a service and see what effect it has.

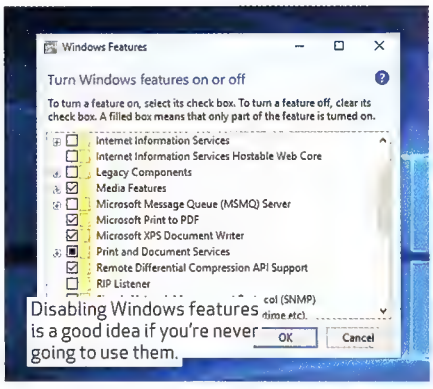


Ultimate removal

Doing Windows your way means only including the applications you absolutely want, using Windows as a base for your operations, and often completely ignoring those apps that Microsoft doggedly protects unwitting users from deleting. We're not suggesting they're useless, and sometimes a core Windows app might be the best choice, but that's for you to decide.

While the surface parts of Windows deny their removal, the deeper toolbox doesn't. Fire up Powershell by right-clicking the Start button, and selecting Windows Powershell (Admin). Now run the command `Get-AppxPackage` (capitalisation is important in Powershell) to list every core app that Windows has installed. Scroll through — it's probably quite a long list — until you find the application you're looking for, and seek out its full name, which is a longer string, including version numbers. Then just type `Remove-AppxPackage <full name>` to strike it from your drive.

One bit of caution here: Don't, whatever you do, remove the Microsoft Store app. While most of these apps can be reinstalled relatively simply if you realise you've made a mistake, removing the Microsoft Store removes it permanently, and also does away with your ability to reinstall other core apps. Whatever you may think of the Windows app pool, the Store itself is getting at least a bit better these days, and you don't have to use it. Just work around the fact that it's still there. This may not be an entirely permanent exercise, either. Future updates are likely to reinstall packages that you've previously removed, and add a few stubborn newcomers to the mix along with them. But now you know how to remove them, you can just go through the process afresh when major new versions of Windows appear.

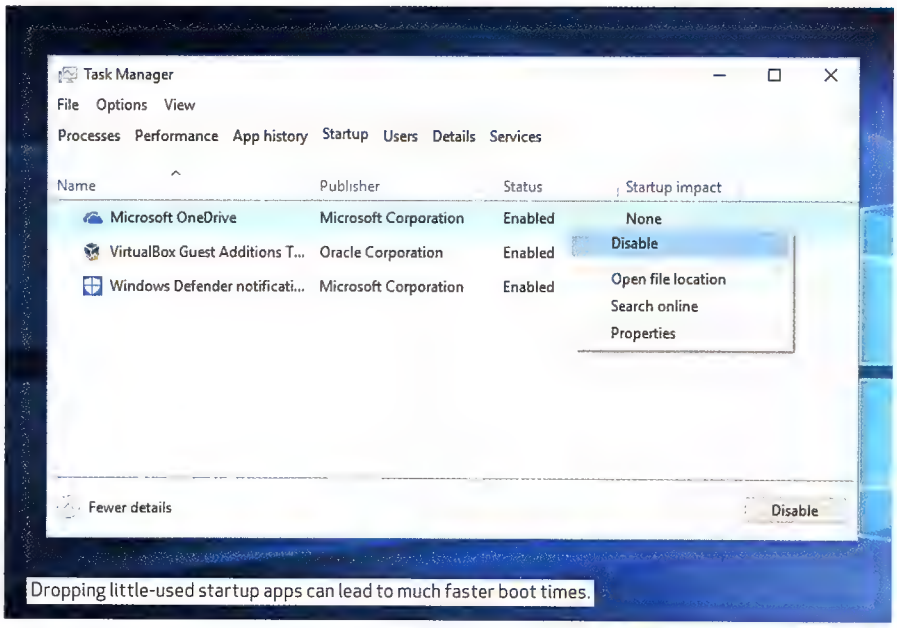

Windows Features
Turn Windows features on or off
To turn a feature on, select its check box. To turn a feature off, clear its check box. A filled box means that only part of the feature is turned on.
Internet Information Services
Internet Information Services Hostable Web Core
Legacy Components
Media Features
Microsoft Message Queue (MSMQ) Server
Microsoft Print to PDF
Microsoft XPS Document Writer
Print and Document Services
Remote Differential Compression API Support
RIP Listener
OK
Cancel
Disabling Windows features is a good idea if you're never going to use them.

wait for it to mount (it may take a couple of minutes), then select Components below Remove in the left column, and accept the dire warning of potential doom that appears.

The full list of features available for removal is going to be pretty daunting, and unless you're generating a kiosk Windows that's designed to be impervious to interference by certain means, there's probably little reason to go too crazy here — you can cut out some of the same services that you might have disabled previously, and really trim the size of your ISO by excluding support for every piece of hardware you know you don't have. You'll see a bunch of stuff in blue — these are components you can't remove unless you pay €40 (about $63) for a full licence.

Check out the Settings, Services and Extra Services panels, too. The former enables you to preconfigure your ISO to look and act just as you'd expect, again saving you time poking around the Settings screen and Control Panel later on, while the latter pair gives you full control over services, as discussed previously. Extra Services, in particular, enables you to manipulate a bunch of services that would usually be pretty inaccessible through Windows itself; switching some of these from Boot to Manual can boost your PC's boot time, although you won't know until you install your image, so this may be a false economy. The Integrate and Automate categories are where you include the software and drivers that you want to integrate into your new ISO — any third-party programs and apps you also want to install on your refreshed PC need to go in the 'Post-setup' section.

When you're done, use the Apply section at the bottom of the list to finish everything off. We recommend opting for the 'Save and trim' option, which cuts out everything but the specific version of Windows 10 you've been working on. Since most ISOs contain multiple editions, and few people have any use for Windows 10 S, N and the like, this is a good way to cut down the size of the install image. ■



Dropping little-used startup apps can lead to much faster boot times.

FULLY ENCRYPT YOUR WINDOWS BOOT DRIVE

Follow Gandalf's wisdom and "keep it secret, keep it safe" via the power of full-disk encryption — no world-destroying gold ring required! Let *APC* be your guide.

We love telling you to do boring stuff with your state-of-the-art PCs: back up your files, update Windows, use strong passwords... Now you can add another one to the list: encrypting your hard drive. But wait, don't turn the page, we're here to show you how full-disk encryption is easy, while ensuring those rascals at ASIO can't access your data without your say-so (precluding any legally permissible enhanced interrogation techniques that our friends in the Department of Defence feel are appropriate).

Turned your phone off and popped on your tinfoil hat? Let's carry on... By default, the files on your Windows PC are accessible to anyone with physical access to it. If you use a local Windows account, it's trivial to reset the password and gain administrator access; a suitably motivated attacker could even reset an online account if they know some personal details.

Sure, for your Steam game files, who cares? But do you really want sensitive documents, accounts and everything else accessible to all? And if you junk an old system, toss a drive or lose a USB stick, if someone randomly picks it up, do you want them to be able to read every file? Of course not! Here comes full-disk encryption to the rescue!

In this guide, we're going to take you through encrypting entire drives. This includes the main scenarios, utilising the most widely used solutions – of which we're sticking with just two. To kick things off, we're looking at the Microsoft-supplied option, because surely that's the best option, right? We'll toss in a few opinions on that further into the article... As for scenarios, we're looking at full-disk encryption for a data disk, removable drives for a container drive file, and finally lead you through setting up your boot drive with encryption, which is really the important one.

As for software, you've probably guessed that the Microsoft solution is its long-standing BitLocker system, which we're covering first. We then move on to something far more flexible, but a touch more complex, in the form of VeraCrypt. Both have their plus and minus points, but they're not mutually exclusive either, so it's not even a case of choosing one or the other, more picking what works best for you. As for encryption technology itself, we're not going to get bogged down with the technicalities here. Even the basics might as well effectively be magic to most people who don't have a PhD in the field of cryptography. We should also dismiss any concerns about performance; similar to compression, it's the initial encrypting that takes the time (even this can be done on the fly and in the background while you work), while the decryption costs a minimal performance hit – around one percentage point – in even oldish processors (going back to Intel's 2010 Nehalem range, and AMD's 2011 Bulldozer range onward) utilising dedicated hardware acceleration via AES commands.

BITLOCKER LAID BARE

Introduced with Windows Vista, BitLocker is seen by Microsoft as an enterprise-level feature, so it's only available on Enterprise, Ultimate and Pro editions of its operating systems. It's likely you're running Windows 10 Pro, so you're good to go. If not, you can either opt to upgrade your version of Windows or, more sensibly, skip ahead to the section on the freely available open-source VeraCrypt.

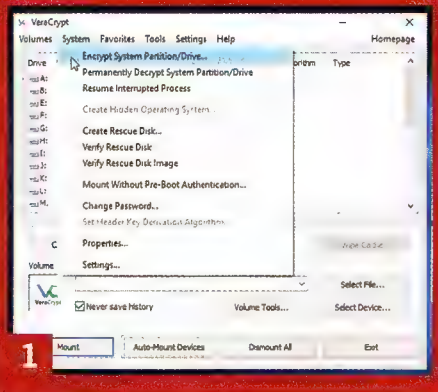
The other major requirement for encrypting the OS boot drive is a system equipped with a Trusted Platform Module (TPM) – it's not essential, because BitLocker can fall back to using a USB key to store the decrypt key, which you may or may not want to do. The TPM is typically part of the motherboard, and is a bit of cryptographic magic that securely stores the decrypt key and maintains the system's chain of trust, among other things.

Why is a TPM so important, and why so many options? During the boot process, there's a chain of trust – how do you know that none of the parts involved in starting your PC have been compromised by malware, rootkits or another evil actor? This goes for the motherboard's BIOS firmware, the bootloader, Windows kernel components and software running on your system. Every stage needs to be protected; all software components should be signed with a secure key and checked via Secureboot. If a driver or module isn't signed, it's not loaded. If the drive is removed and placed in another system, the original TPM won't be found, and your system won't boot; if the TPM is taken, it'll refuse to work in another system. The TPM is designed to be an unwavering guardian of that trust, which flags up any changes in that chain. Enough of this, though, because we're here for just the

> "The TPM is typically part of the motherboard, and is a bit of cryptographic magic that securely stores the decrypt key and maintains the system's chain of trust."

An encrypted boot drive in 10 trouble-free steps

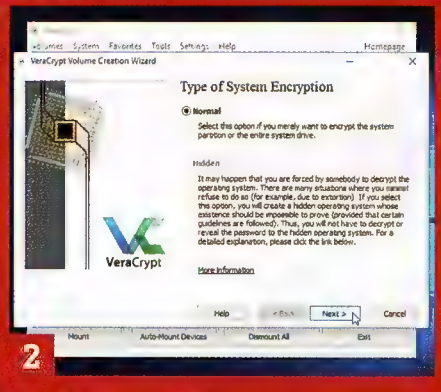
Let's go through the process of setting up an encrypted system boot drive with VeraCrypt. Be warned: There is no recovery process. If you lose or forget your password or keyfile, even the FBI can't help you get your data back.



1

Get and install

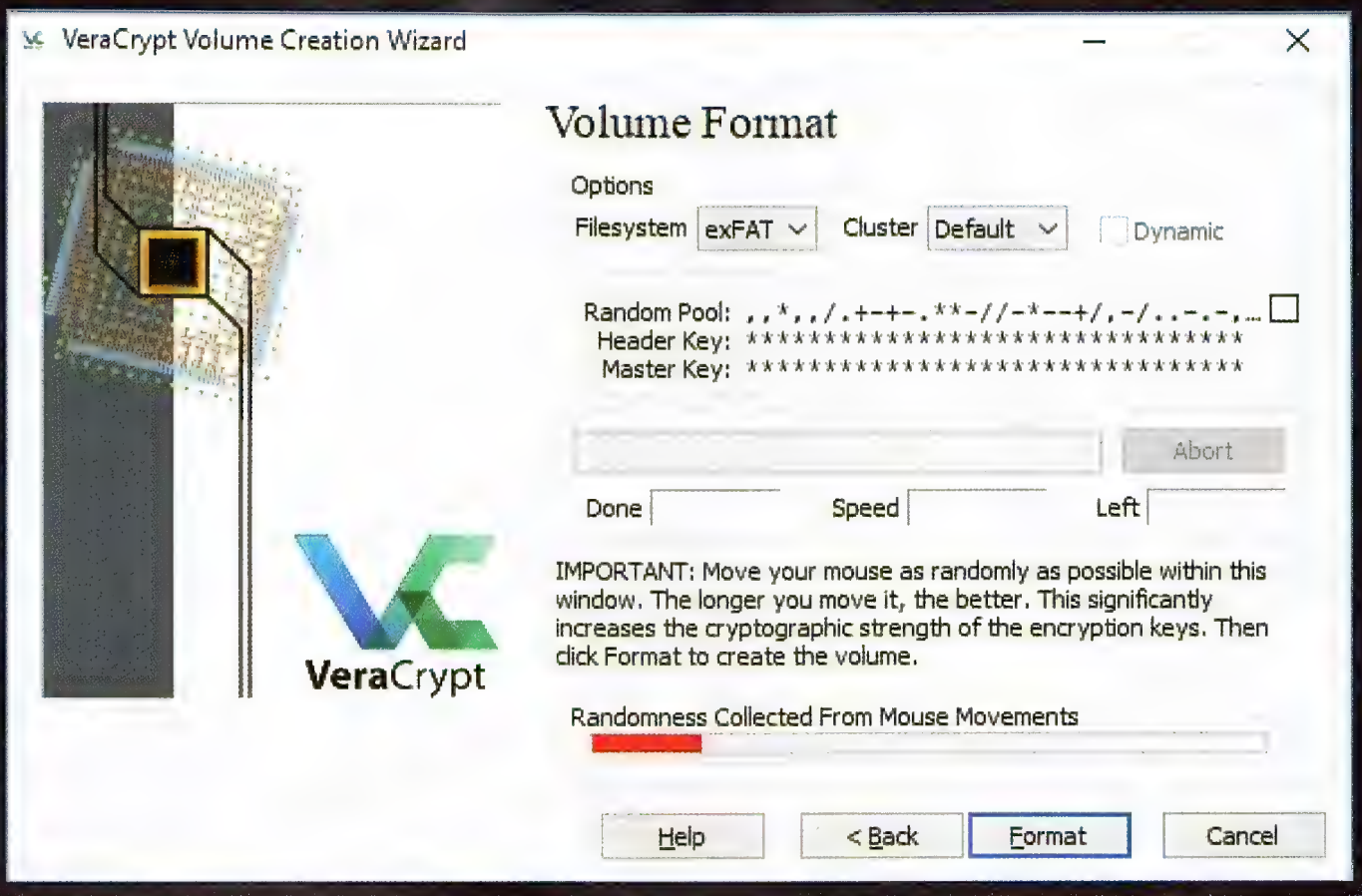
For this guide, we're going to be using VeraCrypt, which lives at **www.veracrypt.fr**, so get yourself over to the website, go to the Downloads tab, then select the EXE file for Windows systems. Run the installer, ensuring you choose the Install option, because that's the only way it will encrypt your boot drive. Fire up the program, then go to the 'System > Encrypt System Partition/Drive' menu.



2

Hidden or Normal

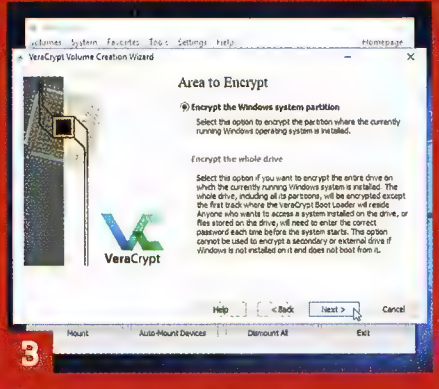
Before you can start the process, there's the option of creating a Hidden system partition – you won't want to do this. It's handy to know about, though, because it enables you to decrypt the drive under duress, and retain plausible denial. We're not going to cover this, because it requires additional tweaking to have it work comprehensively, so we'll just concentrate on the standard Normal option.



Container files

In the walkthrough, we cover creating an encrypted system boot partition. Encrypting a data partition or drive is very similar, minus the recovery and rebooting steps. Click 'Create Volume' in the main VeraCrypt interface, and select 'Encrypt a non-system partition/drive'. There is a third option: 'Create an encrypted file container'. This is a flexible way to store protected data on a fixed drive or removable device. It's a large file that can grow in size (on NTFS devices) when needed, and that VeraCrypt mounts as a standard Windows drive. Choose to create one, pick a location and filename (you can move or rename it later), choose an initial size, and select the Dynamic option, so it resizes on the fly. As it's mounted as a drive, VeraCrypt needs to format it with a filesystem (NTFS is best), and create some entropy for security.

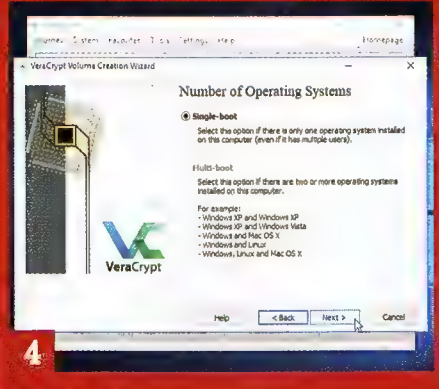
Next, you need to mount this new file. In the main VeraCrypt window, click the 'Select File' button, and locate your container file — subsequently, this is available in the Volume pull-down menu on the left, unless you select not to save the history. The file grows up to the maximum you entered; even so, you can expand this at any point using the 'Tools > Volume Expander' menu.



3

Drive or partition

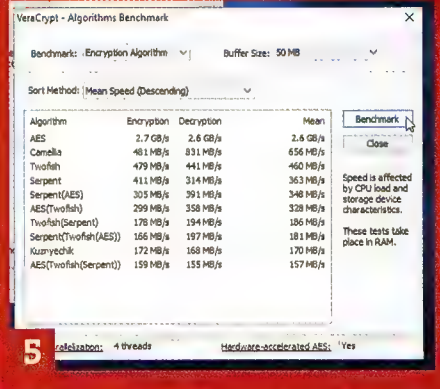
For our system, the only option here is the Windows partition. It's likely that if you're running Windows off an SSD, you're using the whole drive for Windows, so you'll have the same situation. Use the 'Encrypt the whole drive' option to do just that in one go. If you're after protecting all of your files, this is probably the easiest option to choose; protecting partitions separately does enable you to use different passwords and keyfiles.



4

Multi-boot nonsense

We live in crazy times — apparently, people can use more than just Windows 10 on their PCs! There are older versions of Windows for your dad to complain about, people who sit in coffee shops use something called macOS, and we hear the hacker 4chan uses an OS he wrote himself, called a Linux. Choose and perish. The bootloader that VeraCrypt installs can handle all of these and more. Again, we won't be doing that here.


VeraCrypt - Algorithms Benchmark
Benchmark: Encryption Algorithm
Buffer Size: 50 MB
Sort Method: Mean Speed (Descending)
Algorithm Encryption Decryption Mean
AES 2.7 GB/s 2.6 GB/s 2.6 GB/s
Camellia 481 MB/s 831 MB/s 656 MB/s
Twofish 479 MB/s 441 MB/s 460 MB/s
Serpent 411 MB/s 314 MB/s 363 MB/s
Serpent(AES) 305 MB/s 391 MB/s 348 MB/s
AES(Twofish) 299 MB/s 358 MB/s 328 MB/s
Twofish(Serpent) 178 MB/s 194 MB/s 186 MB/s
Serpent(Twofish(AES)) 166 MB/s 197 MB/s 181 MB/s
Kuznyechik 172 MB/s 168 MB/s 170 MB/s
AES(Twofish(Serpent)) 159 MB/s 155 MB/s 157 MB/s
Benchmark
Close
Speed is affected by CPU load and storage device characteristics.
These tests take place in RAM.
Parallelization: 4 threads
Hardware-accelerated AES: Yes

5

Encryption benchies!

VeraCrypt offers a full range and combination of encryption algorithms and hashing schemes. Stick with the default, which is the industry standard AES and SHA-512. Why are we being so mean? Hit the Benchmark button and you'll see your hardware acceleration kick AES to the top of the list by at least fourfold, if not by a factor of 10 or more. The same goes for the hashing system; vanilla default is the tastiest!

encryption, rather than a full-on privacy or infosec feature.

To check whether your system has BitLocker and a TPM, open the Start menu, type `bitlocker` and click the Control Panel option — if there's no BitLocker, you're not running a suitable version of Windows. In the BitLocker window, you should see a list of drives (these should claim BitLocker is off) — ignore these. Click 'TPM Administration' in the bottom-left to see if you have a TPM-enabled system. If not, but you think you do, boot into the BIOS/UEFI, and look for an option to enable the TPM.

Let's assume you do have a TPM. Click 'Turn BitLocker on' next to the drive in question. To initiate and activate the TPM, Windows has to reboot. Once back, you need to create a boot PIN, password or USB key — this is used before Windows will even start loading. Next, a recovery key has to be created in case you forget your password, the USB key explodes, or is left on a train. This can be saved as any or all of these options: to your cloud-based Microsoft account, to a file, on a removable drive or printed out. The encryption is about to begin. Windows offers two approaches: encrypt every byte on the drive, or only used data. The latter is quicker, but doesn't protect deleted data; the former can take a while. The process is done in the background, though, so time may be irrelevant.

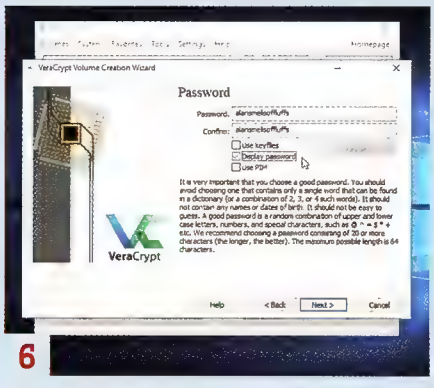
Finally, your Windows 10 PC asks if it should use New or Compatible mode. For fixed drives, you should choose New. For removable drives using On The Go, you might want to choose 'Compatible' if the drive will be used on older Windows versions. Windows now checks compatibility, configures your system, then reboots (using the new login security), and you're done — the drive begins encryption. For data drives and removable media, no TPM is required — just click, create a password, and go.

Finally, we mentioned you don't need a TPM to encrypt the boot disk with BitLocker. If you try, you get an error suggesting you add a policy to enable this, but no instructions. To do this, type "gpedit.msc" in the Search box and hit Return. In the tree directory, navigate to 'Local Computer Policy > Computer Configuration > Administrative Templates > Windows Components > BitLocker Drive Encryption > Operating System Drives'. Double-click 'Require additional authentication at startup', choose 'Enabled' and select 'Allow Bitlocker without a compatible TPM' in the Options box. Click OK. You can now proceed using a USB key or password.

THE VERACRYPT VERSION

That was the pretty straightforward (bar the TPM issues) Microsoft solution. But we can do better, can't we? Allow us to introduce VeraCrypt. If the name sounds familiar, it's because it's the spiritual and source-code successor of TrueCrypt, which was a long-standing and widely used drive encryption tool, going back to 2004. If you were wondering what happened to it, the project was shuttered out of the blue at the end of May 2014. A message urged people to move to BitLocker, and a decrypt-only version was released. Conspiracy theories circulated suggesting the developers had been hit with an NSA gag order, and forced to implement a back door. However, a full source audit found no serious flaws or back doors, and one of the developers named 'David' stated in 2015 the reason was that "there is no longer interest [in maintaining the project]."

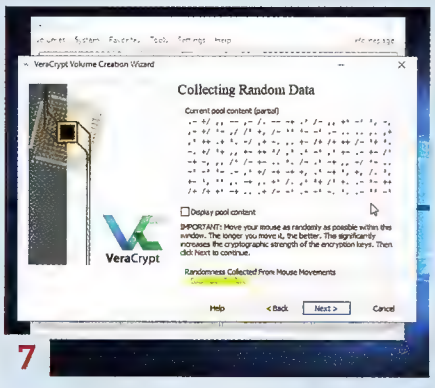
Why do we like VeraCrypt if Microsoft has a perfectly functional BitLocker solution? Because it's open source, so we know it's safe to use, without back doors. VeraCrypt is also portable; it offers an extract-only mode (which won't work on the boot OS partition) that you can copy on to an external drive, and take anywhere. It's also available for Windows, macOS, BSD and Linux, so encrypted drives or container files can be read by almost anything. It's also super-flexible, with modes for data drives, the boot partition, removable drives, hidden drives, and flexible container files. There's no need for a TPM, while there are options for any combination of passwords, keyfiles, smart cards and so on. Our 10-step walkthrough (started back over the page) explains the rest.



6

Password

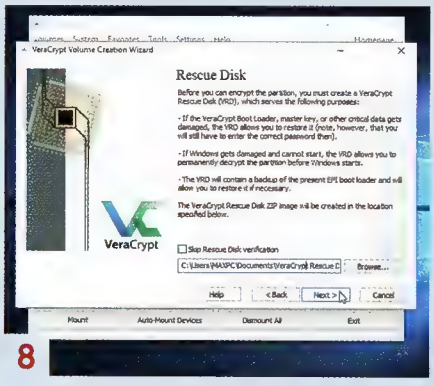
Before you can go any further, you need to set a strong but memorable password. Take a quick look at **www.xkcd.com/936** for a simple explanation of password strength, aka entropy. You're going to enter this password every time you boot, so making it memorable would be useful. Unfortunately, keyfiles can't yet be used for system boot drives, which makes us sad, because they're great (see the boxout, above-right). Hint: Don't use Password123.



7

Gathering entropy

The next part of the process might seem a little odd, but that's because of the complexity of generating true randomness that digital systems struggle to do. You'll need to move your mouse around erratically to generate enough 'entropy' for VeraCrypt to generate a truly random set of keys — the longer you move it, the better, but you can hit Next at any point. The keys are then created in the next step.



8

Rescue disk

We cover the rescue process in the boxout on the right, but this is the stage where you create the data files. This contains a duplicate of the existing EFI bootloader, so you can restore everything back to how it was — be aware you still need your password to decrypt the data; there is no recovery for that. VeraCrypt insists you extract the created ZIP file to the root of a USB drive that's formatted to FAT or FAT32. So do that.

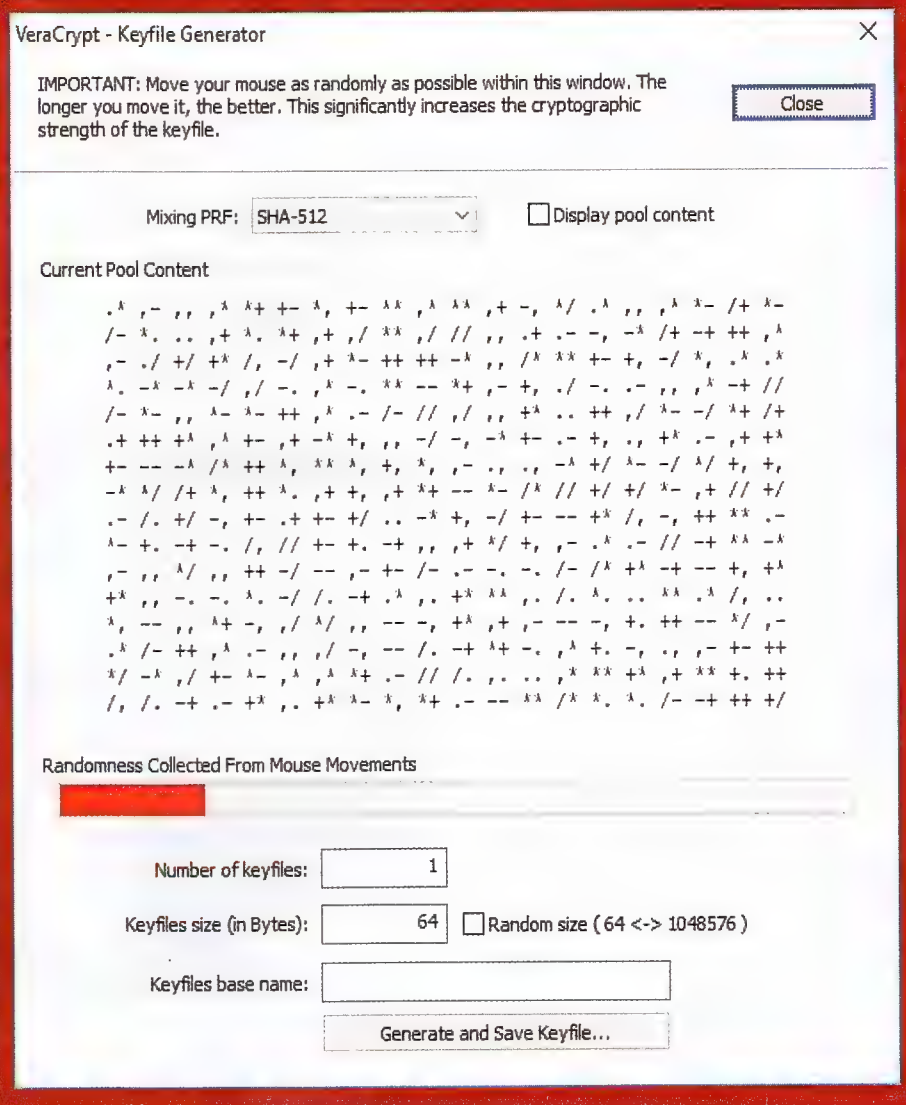
Keyfile defense

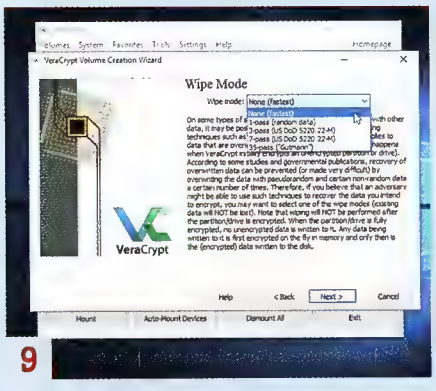
We mention keyfiles in the 10-step walkthrough below, largely to say that they don't work with a system boot drive. However, keyfiles are one of the best ways to improve your encryption security, because they add a second factor of authentication to the procedure — you need both your password and the keyfile (which can be stored anywhere) before VeraCrypt is able to decrypt your data drive or container file.

Keyfiles are useful because they boost security, especially if you're using a weak password. Enable multiple people to access the same file — don't use a password, just give them all the same keyfile — and it enables shared access when multiple people want a file protected; multiple different keyfiles can be used to lock a volume, and all must be present to open it.

Technically, you can use any file as a keyfile: that MP3 over there, that icon file here or a photo you've taken. VeraCrypt only uses the first 1,024kb of the keyfile, so do be wary, it might sound clever using an image or MP3 file, but if a single bit changes (something re-encodes the JPEG or MP3) in that first 1,024kb, you lose all access to the encrypted volume. Keyfiles can also be generated for you, which is a little more sensible.

When you come to mounting a volume, just point VeraCrypt at where the keyfile is stored. This could be on a local drive, the desktop, a network share or a removable USB drive. You'll want to keep a backup somewhere secure, just in case you lose it.

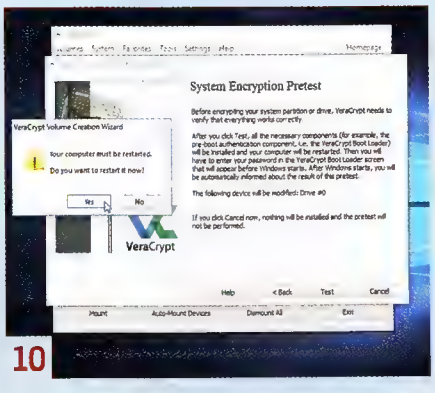

VeraCrypt - Keyfile Generator
IMPORTANT: Move your mouse as randomly as possible within this window. The longer you move it, the better. This significantly increases the cryptographic strength of the keyfile.
Close
Mixing PRF:
SHA-512
Display pool content
Current Pool Content
Randomness Collected From Mouse Movements
Number of keyfiles:
1
Keyfiles size (in Bytes):
64
Random size (64 <-> 1048576)
Keyfiles base name:
Generate and Save Keyfile...



9

Wipe mode

Engage paranoia mode! VeraCrypt offers to wipe the drive with semi-random data to avoid attackers recovering data from it. You are most probably in the happy position that this isn't an issue, so can select None. Even if you are paranoid, a single pass on modern drives permanently removes data. The '35 times' urban myth was from a study done on ancient IBM-style Winchester drives, and is no longer applicable.


System Encryption Pretest
VeraCrypt Volume Creation Wizard
Your computer must be restarted.
Do you want to restart it now?
VeraCrypt

10

Test and go

The highly paranoid VeraCrypt is all but set to go. It insists on running through a test cycle to ensure the new bootloader is working correctly before it encrypts your data. You need to enter the password, and Windows boots. If it doesn't, read the 'Don't Panic' box on the right. Back in Windows, you can start the encryption process, and we're done! You do this at your own risk; if you forget your password, your data is irretrievable.

Don't Panic! (perhaps a bit)

During the test reboot, if Windows fails to start or your password isn't accepted, restart the PC, and press Esc at the VeraCrypt login screen. If you have a multi-boot system, choose Windows, else it just starts, and you can choose to remove the bootloader. If the bootloader isn't appearing, you need to boot from the rescue disk you created. (You did, didn't you?) Insert your USB stick or CD, and wait for the rescue screen. If it doesn't appear, you need to change the boot device. Many systems offer a boot menu accessed by tapping F9 (HP), F12 (Dell, Lenovo), F8 (Amibios) or F11 (Award BIOS) while booting.

The VeraCrypt Rescue Disk screen should now appear. Select 'Repair Options' by pressing F8, then select 'Restore original system loader'. Remove the rescue disk and restart your computer. Windows should start normally (if it is not encrypted). The previous steps do not work if the system partition or drive is encrypted. Nobody can start Windows or access encrypted data on the drive without the correct password. ■

how to

» QUICK TIPS

Experts solve your computing problems

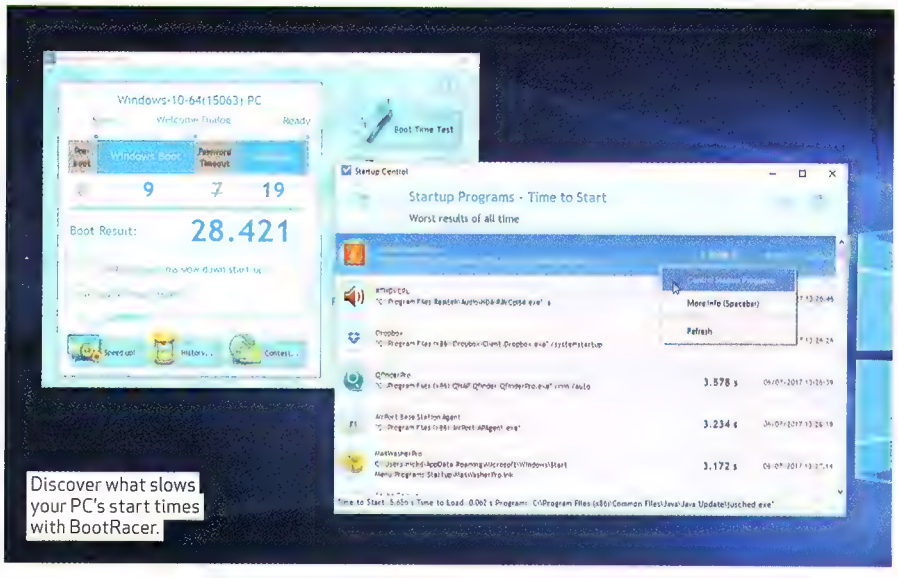
APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

IDENTIFY BOOT BOTTLENECKS

Since installing the Creators Update, my PC is taking much longer to boot. Any pointers?
Julia Rendbury

A lot of people have complained on user forums about the Creators Update resulting in noticeably slower boot times. The key thing is to pinpoint where the bottleneck occurs. To determine where it is, download and install BootRacer (**www.greatis.com/bootracer**), which will time your boot and split it into four stages. The pre-boot time should be around 3–5 seconds on a PC with Fast Boot enabled – if not, check your UEFI settings to see if the option's available (it should be on most modern PCs). If the bottleneck appears to be linked to the Windows Boot portion of startup, it may be caused by disk errors. Right-click the Start button and choose Command Prompt (admin), then type `chkdsk c: /f /r /x` and hit Enter, rebooting your PC to run a check. Be patient – it may take some time to complete and appear to be stuck. If this doesn't improve matters, go to 'Start › Settings › System › Power & sleep › Additional power settings' and verify 'Turn on fast start-up' is enabled under 'Choose what the power buttons do' (if it's not, click 'Change settings that are currently unavailable' to tick the box). Finally, a lengthy Desktop time refers to start-up programs (click Enable Control for more detailed analysis to identify the culprits). You can then disable these within BootRacer or via the Start-up tab under Task Manager.
Ian Evenden



Discover what slows your PC's start times with BootRacer.

RASPBERRY PI

TOUCHY FIREFOX

I am trying to build an information system using a Raspberry Pi running Raspbian and a touch screen. I thought I could drive everything from Firefox running in fullscreen mode and displaying everything in HTML. I have some recollection of a kiosk mode option, but I can't find it. Can I do what I want? If so, how?

The other thing that would be useful is to be able to know when there has been no input for a while and return to either a home page or a slideshow. Could I somehow use the screensaver to run a command to load a new page?
Liam Donnelly

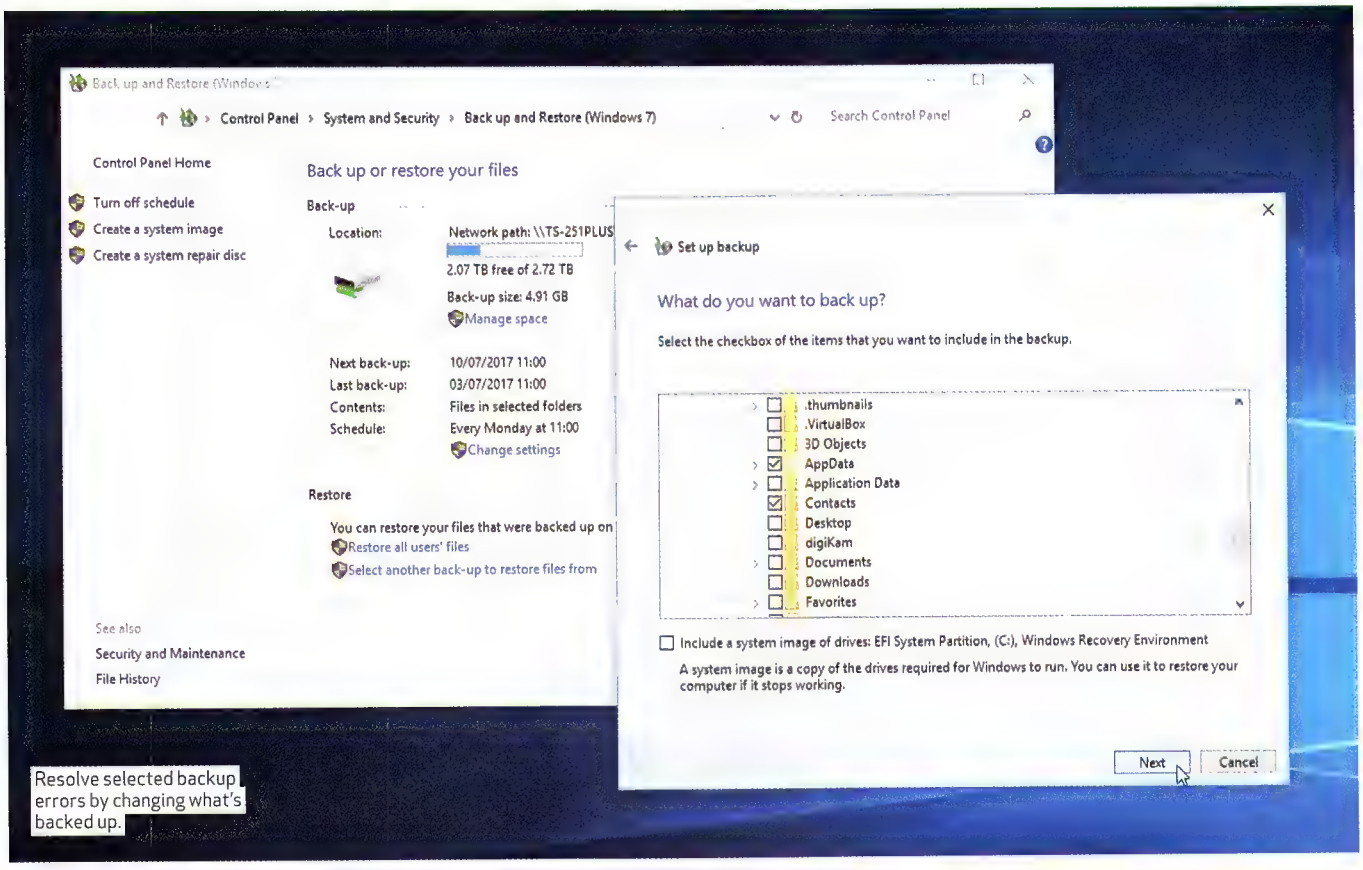
We have set up a system like this and found a couple of ways of doing it. The simplest is to use the mKiosk extension. The mKiosk add-on not only has an option to start the browser fullscreen, it can also jump to a specific page after a set period of inactivity. There are several other options you can use to run Firefox as you want. We found it didn't quite suit my needs and switched to using a couple of other extensions and a shell script.

First, install the Run Fullscreen extension in Firefox. This does exactly what it says and causes Firefox to run in fullscreen mode. With only left-mouse button control offered by the touchscreen, this means the browser is locked in fullscreen mode. We then used a script called xprintidle to reload the home page after five minutes of idle. The reload command is sent via the remote control extension from **addons.mozilla.org/en-GB/firefox/addon/remote-control**. The remote control extension allows you to send JavaScript commands with telnet or netcat. By default, it only listens on localhost, using port 32000, which can be changed in the preferences. To force loading of a local page, you would use something like

```
echo 'window.location="file:///www/index.html"' | netcat localhost 32000 &
```

All that remains is to run a script that checks how long the system has been idle, using `xprintidle`. This command prints the number of milliseconds since the last input event, which is a little too precise for this application so we divide it by 1,000. Then we compare that with the limit we have set, if the limit is exceeded, we force a page load. If not, we work out how long is left and set it to go to sleep for that time before checking again. The full script is below, the `MAX_IDLE` setting is how long the system should be idle for before loading the default page, in seconds.

```
#!/bin/sh
MAX_IDLE=300
while true; do
  let "CUR_IDLE = $(xprintidle) / 1000"
  if [[ $CUR_IDLE -lt $MAX_IDLE ]]; then
    sleep $(( MAX_IDLE - CUR_IDLE ))
  else
    echo 'window.
```


Back up and Restore (Windows 7)
Control Panel › System and Security › Back up and Restore (Windows 7)
Search Control Panel
Control Panel Home
Turn off schedule
Create a system image
Create a system repair disc
Back up or restore your files
Back-up
Location:
Network path: \\TS-251PLUS
2.07 TB free of 2.72 TB
Back-up size: 4.91 GB
Manage space
Next back-up: 10/07/2017 11:00
Last back-up: 03/07/2017 11:00
Contents: Files in selected folders
Schedule: Every Monday at 11:00
Change settings
Restore
You can restore your files that were backed up on
Restore all users' files
Select another back-up to restore files from
See also
Security and Maintenance
File History
Set up backup
What do you want to back up?
Select the checkbox of the items that you want to include in the backup.
.thumbnails
.VirtualBox
3D Objects
AppData
Application Data
Contacts
Desktop
digiKam
Documents
Downloads
Favorites
Include a system image of drives: EFI System Partition, (C:), Windows Recovery Environment
A system image is a copy of the drives required for Windows to run. You can use it to restore your computer if it stops working.
Next
Cancel
Resolve selected backup errors by changing what's backed up.

After using the old Windows 7 Backup tool to back up to my external hard drive, I received the following error: "Check your backup results. The backup completed but some files were skipped".

```
location="file:///www/index.
html"' | netcat localhost
32000 &
      sleep $MAX_IDLE
    fi
  done
```

The script runs forever, you could even add a line at the top to start Firefox in the first place then run this script from the autostart file or you could start Firefox independently, it is up to you.

APC Team

WINDOWS
FIX BACKUP AND RESTORE ERROR

I'm running a new PC and have switched from Windows Live Mail to Outlook. Recently, after using the old Windows 7 Backup tool to back up to my external hard drive, I received the following error: "Check your backup results. The backup completed but some files were skipped". I investigated further to discover two errors (0x80070002) referring to C:\Users\defaultuser0\Contacts and C:\Users\defaultuser0\Searches (neither file could be found). The Windows Troubleshooter was no help — can you resolve this please?

Allan Bolton

This is a well-known error, and the good news is that you can safely ignore it if you wish – the backup still works. However, you may want to remove the annoying message that will continue to appear. Open Backup and Restore - press 'Win-R', type `sdclt.exe` and click OK – and then click 'Change settings'. Click Next, then select 'Let me choose' if necessary and click Next.

Expand 'Data Files' followed by '[Username's] Libraries › Additional Locations' and clear the tick boxes next to the AppData folder, Contacts and Searches. Now expand 'Computer › C: › Users › [Username]' and tick the AppData, Contacts and Searches folders if they exist. Click 'Next' followed by 'Save settings and exit', then perform a fresh backup to verify the issue has been resolved.

Cat Ellis

SOFTWARE
FIX CD-TAGGING PROBLEMS

I've been using Mp3tag for a while now, but there are some CDs with generic names that the Discogs search can't find. Can you help?

Roy Palmer

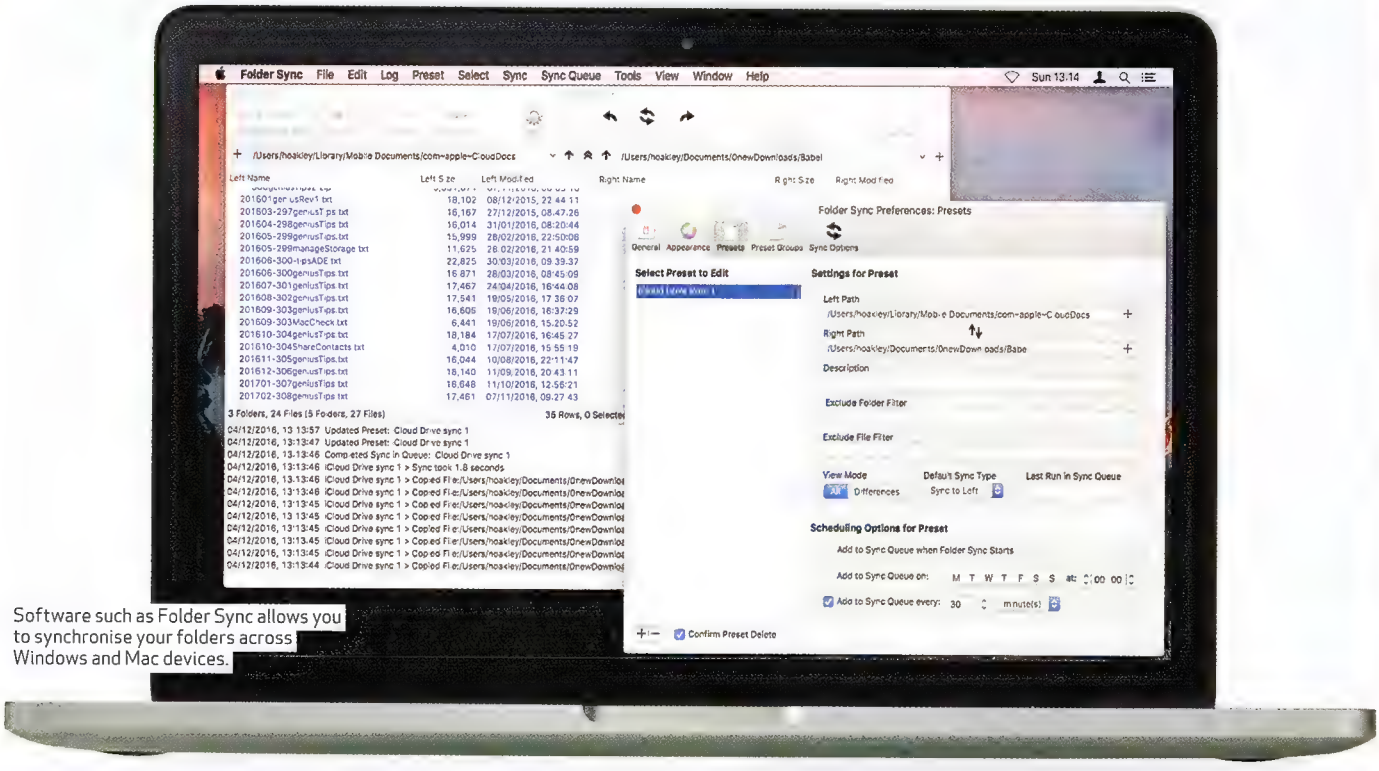
If you upgrade to the latest version of Mp3tag – version 2.83 or later – you'll find that a new option has been added to the Tag Sources list: Discogs Release ID. Here's how to use the app to find the correct match for your CDs.

Locate album on Discogs: Point your web browser to **www.discogs.com** and search for the artist in question. Click their artist entry and then use the Releases sidebar on the left to locate the album, single or compilation you're after. Click its title to access its page.

Discover release ID: Scroll through the list of releases looking for an exact match using the catalogue number to help identify it. Click this release, verify it's the correct one and then copy its ID from your browser's Address bar.

Input release ID: Open Mp3tag and choose 'File › Change Directory...' to select the folder of the album that you wish to tag. Now select all the tracks and open 'Tag Sources › Discogs Release ID'. Paste in the release ID from the previous step and then click Next.

Match and tag: Check the information matches (and make sure the tracks line up correctly) – click OK to tag your


Folder Sync File Edit Log Preset Select Sync Sync Queue Tools View Window Help
Sun 13:14
Folder Sync Preferences: Presets
General Appearance Presets Preset Groups Sync Options
Select Preset to Edit
Settings for Preset
Left Path
Right Path
Description
Exclude Folder Filter
Exclude File Filter
View Mode
Default Sync Type
Last Run in Sync Queue
Differences
Sync to Left
Scheduling Options for Preset
Add to Sync Queue when Folder Sync Starts
Add to Sync Queue on:
Add to Sync Queue every:
Confirm Preset Delete

Software such as Folder Sync allows you to synchronise your folders across Windows and Mac devices.

files with the metadata provided. If no cover is provided, you could download this separately from Discogs and manually add it to your files.

Nick Peers

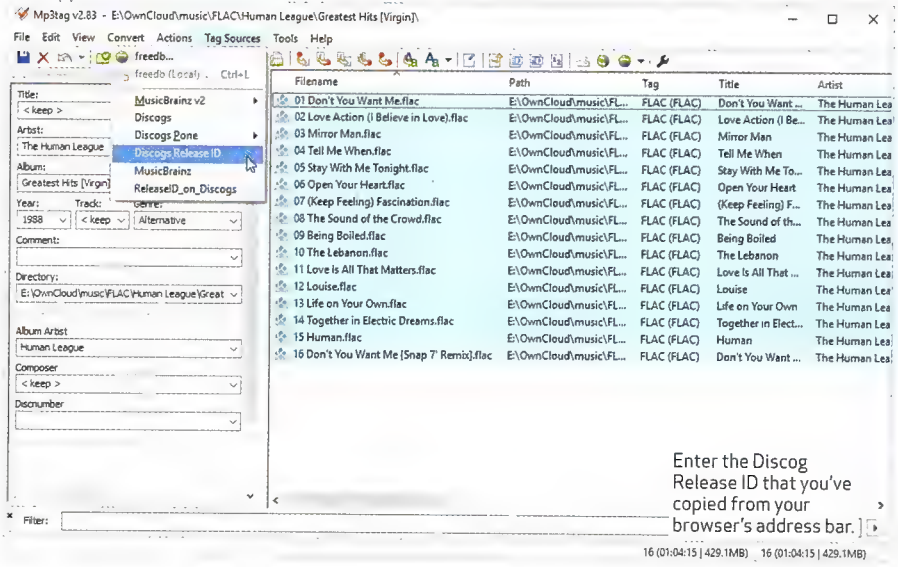
MAC
CROSS-PLATFORM SYNCING WITH ICLOUD

I'm delighted with my new MacBook Pro, but I still use a Windows PC too, so I'd like to use iCloud to keep files and folders synchronised between them. Is it possible to automatically update changed files on my PC to iCloud, and with my Mac, too? I want to keep originals on my PC, and have them copied to my iCloud Drive.

Kevin Duffy

There are two ways to use iCloud for this type of synchronisation. The simpler way is to work on the files in iCloud, and only make local copies for backups and archives. This is easier because you don't have to do any synchronisation, just pull down copies when you want to back them up locally. You can use iCloud Drive as a means of synchronising local copies, as you've said you would prefer. Of the two methods, this is inevitably the more complicated option, as it requires local software that copies from each computer whenever you make changes to the local copy of each file. If you're not careful, the iCloud copy won't be up to date, and you could end up with different versions of files on your Mac and PC. To implement the second method, you'll need folder synchronisation software running on both your Mac and your PC. It must be able to see your iCloud Drive so it can copy to it, and it must run automatically. For your Mac, the Mac App Store has good options, such as Folder Sync ($13.99).

Howard Oakley



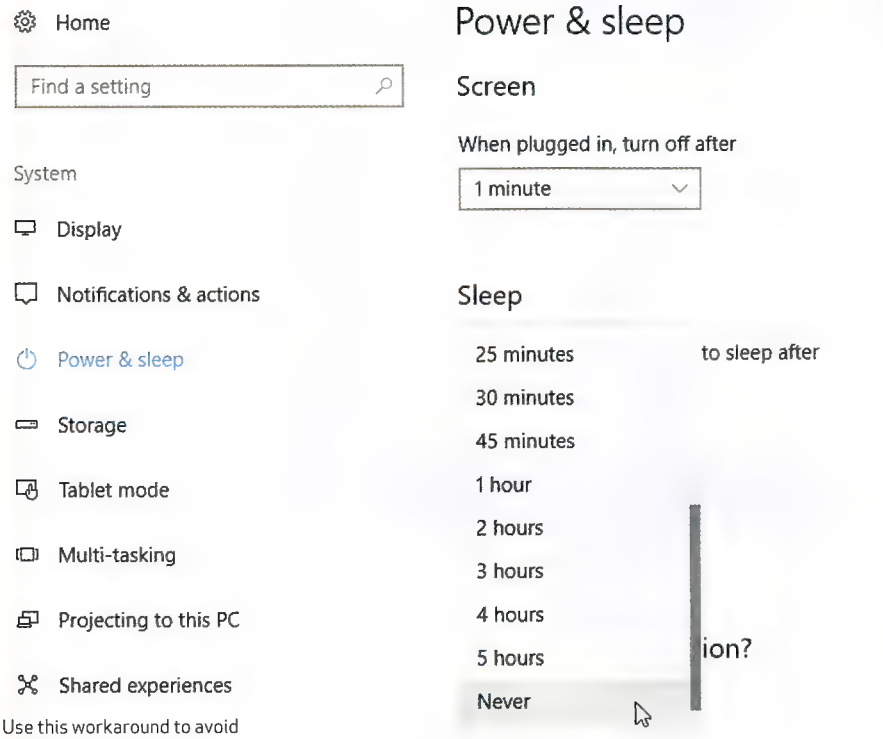
Enter the Discog Release ID that you've copied from your browser's address bar.

HARDWARE
PC WON'T SUCCESFULLY BOOT

After successfully installing the Creators Update followed by my Nvidia graphics drivers, Windows 10 will no longer boot — after 10 minutes of going nowhere, it puts me into Repair mode and then finally allows me to restart in Safe mode. Can you provide me with some pointers for what I should try to do next?

Tony Prodger

We first thought the problem might be the driver update, so pointed Tony to a tool he could use in Safe mode (Display Driver Uninstall Tool, available at **www.wagnardsoft.com**). However, the situation quickly deteriorated – and switching to another graphics card known to work with Windows 10 had no effect. Eventually, his power supply failed after a fan jammed, and after replacing this, Tony was forced to reinstall Windows 10 from scratch. Everything proceeded normally except for a power-saving issue whereby the PC would freeze after



Use this workaround to avoid sleep-related crashes.

10 minutes, when it tried to enter low-power mode. By going to 'Start > Settings > System > Power & sleep', you can set the Sleep setting to Disable to work around the problem while carrying out other troubleshooting options.
Matt Hanson

LINUX
AUTOMATED EMAIL

Before I retired, I worked in a Microsoft environment. Using VBA, I could control Outlook to send emails as and when required at the touch of a button. I now wish to replicate that under Ubuntu 16.04 — can this be achieved using Thunderbird or some other email service and maybe Gambas or C# on Mono?
Mike Higgins

Sending emails from the command line with Linux is easy and doesn't need a specific language or mailer. The easiest way is with the mail program, a command line mailer. All you need to do is create the email then feed it to mail, for instance:

```
$ mail -s "A test mail" me@example.com <mail.txt
```

...where the file 'mail.txt' contains the body of your mail. You can also send content directly without creating an intermediate file.

```
$ echo "This is a test" | mail -s "A test mail" me@example.com
```

Whatever mail receives on standard input is used as the mail body, you can also add headers with the `-a` option and extra cc and bcc recipients with the `-c` and `-b` options, respectively:

```
$ cat mailbody | mail -a "X-Mailer: Hacky Script 0.1" -b me@home -s "test" me@work
```

Any arguments that contain spaces must be quoted to avoid confusing the shell. There are various other options documented in the man page but these are the main ones. Mail needs a local email server running, which is traditional in the *nix world. The server receives the emails and sends them on to their destination. If you don't have one installed, you can use a simple forwarding mail daemon,such as nullmailer. This simply listens for local emails and forwards them on to your ISP's mail server. It should be in most distros' software repositories for installation in the usual way.
You then tell it where to send the mail by editing, as root, the file /etc/nullmailer/remotes. This can be as simple as one line:

```
mail.example.com smtp
```

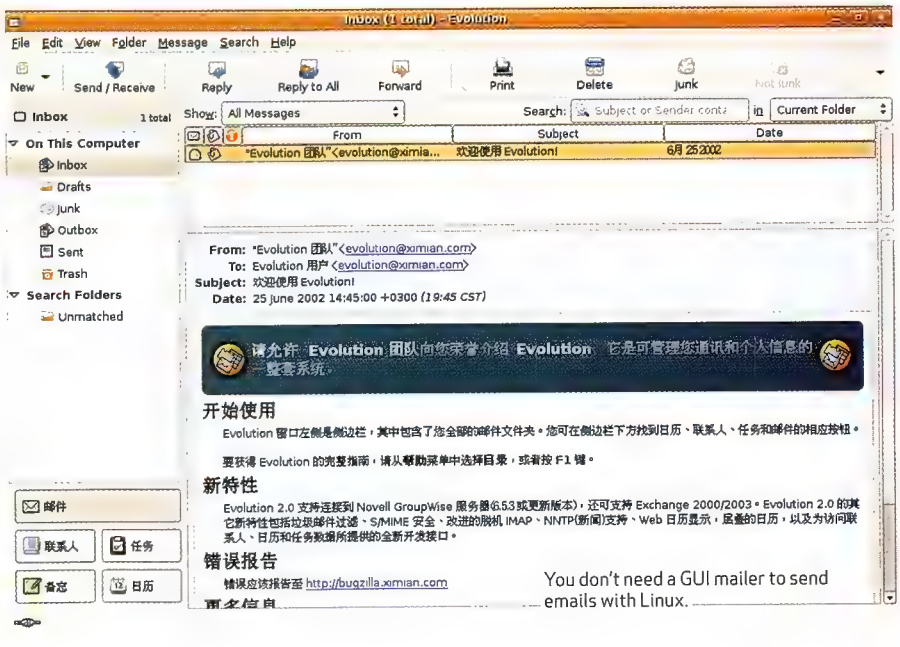
This tells nullmailer to send all mail through mail.example.com using the SMTP protocol (the standard way of sending mail). Most mail servers require authentication, so a more useful example, for sending through a Gmail account, is:

```
smtp.gmail.com smtp --user=you@gmail.com --pass=yourpassword --port=465 --auth-login --ssl
```

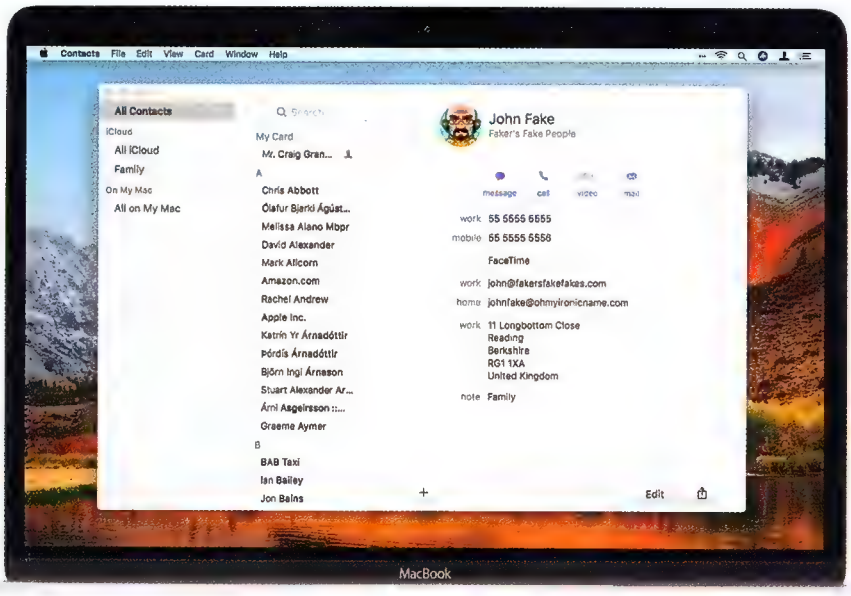
As the remotes file contains passwords, it shouldn't be readable by normal users. Editing as root should not change this but to be on the safe side, run:

```
$ chmod 600 /etc/nullmailer/remotes
```

You can also edit the other files in /etc/nullmailer but this is not essential. The man page has all the details. This is the easy way to send mail from a terminal or script. If you want to do it from a 'proper' programming language, most of them have modules or libraries to handle sending mail, for example Python has smtplib, which does the job with ease.
APC Team



You don't need a GUI mailer to send emails with Linux.



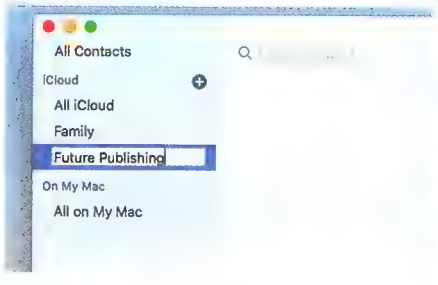
Pro tips for the macOS Contacts app

When it comes to Contacts, Craig Grannell reckons you can do more on a Mac than on iOS.

These days, Apple makes quite a big deal about how a lot of its apps are broadly the same on macOS and iOS. Even if you're using just an iPhone, you get the majority of the features of Numbers or GarageBand in the palm of your hand. Which is great until you realise you need to use some of the bits that Apple left out.

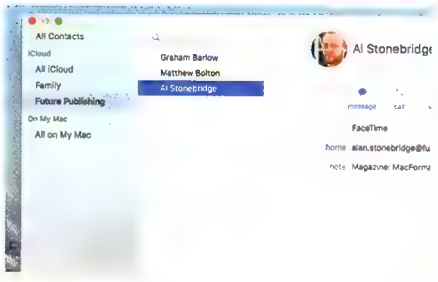
Given its relative simplicity on the Mac, it's perhaps surprising to realise that Contacts isn't quite as feature-rich on the iPhone and iPad. Sure, you can easily access all your contacts (assuming you're using iCloud), and the interface is all very ritzy. But can you create groups? Nope. Smart groups? No way. Export contacts in a range of formats? No. How about set up a more private version of your own card to share with others? Not easily, no. Fortunately, you can do all of these things at speed on the Mac. This guide shows you how, even if what you're ultimately aiming for is a printed version of your address book. We'll also provide a quick peek at Cardhop, a kind of third-party 'pro' take on Contacts from Flexibits, the team behind Fantastical.

How to: Create groups in Contacts



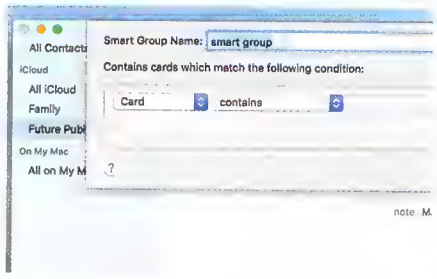
1 MAKE A NEW GROUP

Hover over the iCloud header in the sidebar and click + (or choose 'File > New Group') to create a new contacts group. Give your group a memorable name. The group will sync to your iOS devices and between Macs.



2 ADD CONTACTS

Click 'All Contacts' at the top of the sidebar to show your contacts. To add people to a group, just drag them over the group's name and let go. To remove people from a group, click the group, then a name and press Delete.

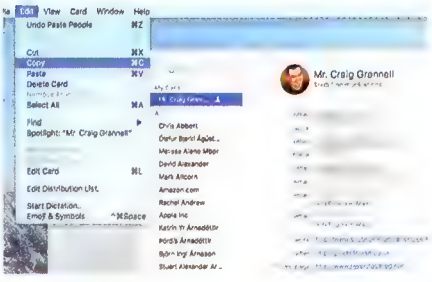


3 USE SMART GROUPS

Choose 'File > New Smart Group' and add some conditions; matching items will automatically be added. Smart Groups don't sync via iCloud, but can be used in Mail. (Give them a name starting with "SG" for faster access.)

How to: Make your own card more private

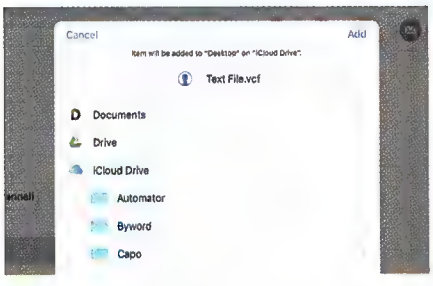
1 CREATE A 'ME' CARD
Go to 'Contacts > Preferences' and select vCard. Check 'Enable private me card'. At the top of All Contacts, select your card and click Edit. In the Share column, turn off items that you don't want included when exporting.



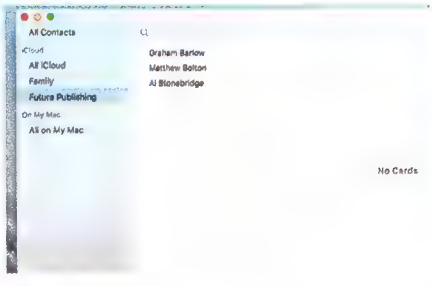
2 COPY AND PASTE
The private 'me' card is a Mac-only feature. A workaround to get a private card on iOS is to make a duplicate of your existing card and then adjust its details. To get started, select your card, and copy and paste it.

3 USE ON IOS
In the copy of your card, delete the fields or elements you don't want to share with others. Consider differentiating it from your full card with a specific photo, so you don't accidentally send out the wrong one. (*Egad, it's hideous! — Ed*)

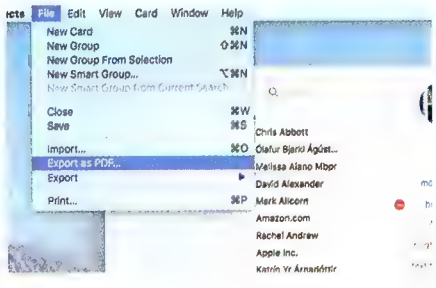
How to: Export your cards



1 CHECK OUT IOS
On iOS, you can scroll to the bottom of any Contacts card and tap Share Contact. It can be sent to any app, including Files, but is always given the generic name 'Text File.vcf', which you'll later need to change.



2 DRAG AND DROP
In Contacts for Mac, the process is swifter and smarter. Drag a contact's record from Contacts to Finder (or any other app) and it retains the name of the contact. The exported file is otherwise identical to that on iOS.



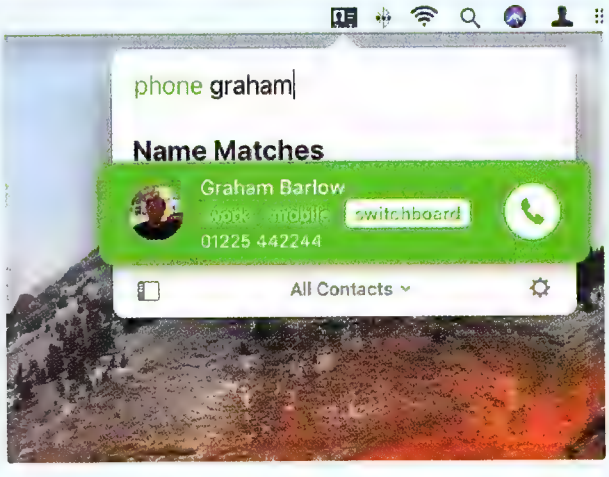
3 EXPORT TO PDF
Want an old-school list of your contacts? Select one or more of them, a group or All Contacts, and choose 'File > Export as PDF'. Congratulations! You now have a traditional address book you can archive or print out.

Start using Cardhop

Faster, smarter and menu bar-ie.

Although it's a fairly powerful app on the Mac, Contacts isn't particularly pleasant to use. By contrast, CardHop ($30.99, **flexibits.com**) is the Mac app equivalent of a loyal dog — always sitting patiently in the menu bar, desperately eager to please.

Cardhop's natural language input makes it a cinch to add and edit contacts or to perform actions like making a call or emailing someone. The Notes field is also front and centre during searches, for when you need to recall your mum's friend's children's names. That feature alone might be worth the money, to be honest...!



Use iOS's Notes app to scan documents

Roland Waddilove shows how to scan documents using your iPhone and store them in the Notes app.

The camera on your iPhone is so good, it can be used as a scanner to capture documents, receipts and other paper-based items so you don't lose them, they won't fade, and they're easier to find and organise (when it's time to file your tax return, for example). There are dozens of excellent scanner apps in the Store, but do you need one? Apple has upgraded the Notes app in iOS 11 and it now includes a great scanning feature. This enables you to scan all your paperwork and store the images in notes on your phone. With iCloud syncing, you can then access the scans on your Mac and other devices if you need to. Here's a quick introduction to how it works...

1 FLASH OPTIONS
Tap here to set the camera flash to on, off or automatic mode. Usually, automatic is best, but it depends on the ambient lighting and the document.

2 COLOUR OPTIONS
Choose between photo mode, colour scan, greyscale and black-and-white. Selecting the last of these options will really pump up the contrast.

3 AUTO SHUTTER
The app can automatically take the photo when it detects the document in the picture. Tap here and turn this off if you'd prefer to use the Scan button (the big round one) at the bottom.

4 SAVE THE SCAN(S)
Multiple documents can be scanned in one go — just keep putting them in front of the camera. Tap the Save button to save all scans to the note when you're done.

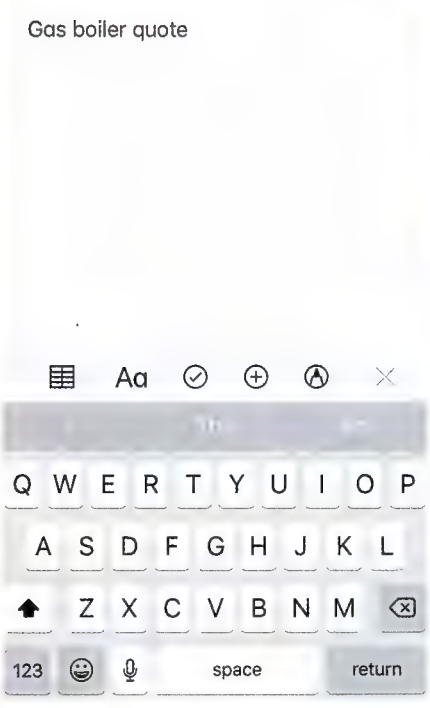
How to: Organise scans

Documents, photos and receipts can be scanned and saved in any note, but you might want to create a special folder to store them in. Organising your notes can make it easier to find the items you need without having to wade through all your shopping lists. Here's how to create a folder for your scans and later find them again. Bear in mind that folders you create are always sorted in alphabetical order, while the notes within them are always displayed in date order, with the newest at the top of the list.

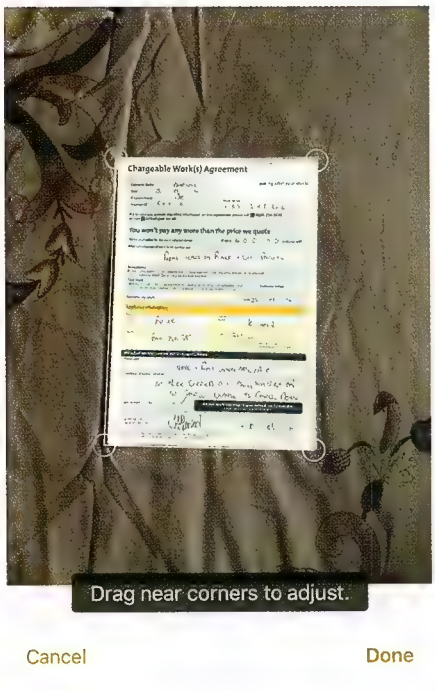
1 CREATE A FOLDER
Open the Notes app — if you are in a subfolder, tap the back button in the top-left to reach the Folders screen. Tap 'New Folder' at the bottom and enter a name for the folder — Scans, Receipts or whatever is appropriate.

2 FIND YOUR SCANS
When browsing the notes you have made, tap the icon in the bottom-left corner of the screen to display attachments to notes. Our scans are in the Scans folder, and tapping 'Show All' displays them.

How to: Scan a document in the Notes app



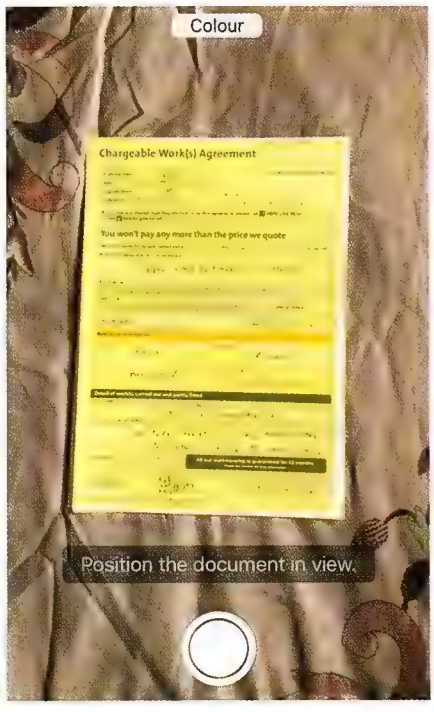
1 CREATE A NOTE
Open the Notes app on your iPhone and create a new note. It's a good idea to enter some text because this will be used as a title, helping you to find scanned items later.



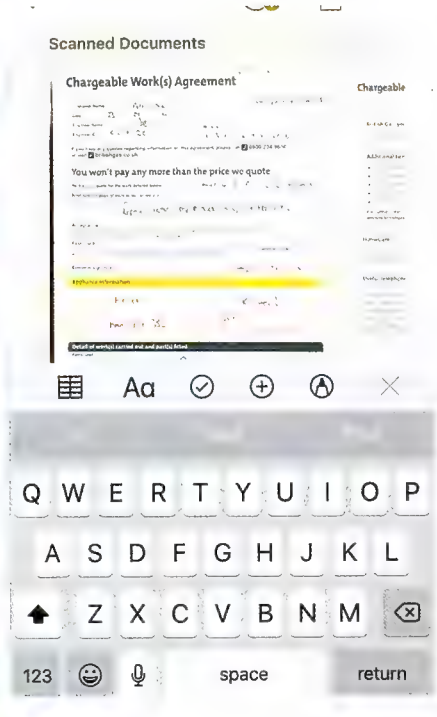
4 ADJUST THE CROP
Most of the time, the app will automatically detect the edges of the document and crop the background for you. If need be, you can reposition the corner markers manually.

2 SHOW THE MENU
The row of buttons in the toolbar above the keyboard gives you access to additional options. Tap the plus icon, then tap Scan Documents at the top of the sheet that opens.

5 REPEAT AND SAVE
Place your next document or receipt in front of the iPhone camera and let the app scan it. When you've scanned all your items, tap the Save button in the bottom-right corner.



3 SCAN THE DOCUMENT
Place your document on a dark background for contrast and point the iPhone at it. Follow any instructions displayed at the foot of the screen, and a scan is automatically recorded.


Scanned Documents
Chargeable Work(s) Agreement
You won't pay any more than the price we quote
Aa
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
123
space
return

6 EDIT AND SAVE
The scanned items appear in Notes, and you can tap them to view them, enter additional text, draw on them and more. When you're done making edits, tap Done at the top. ■

Tweak and customise the Gnome desktop

Nate Drake shows you how to customise your Gnome desktop running on your favourite distro, to suit your everyday needs.

For those of you who have recently installed Ubuntu 17.10, you'll be graced with the new-look Gnome Shell. This is the graphical part of the desktop environment. If you're new to Linux, then you may be surprised to find that the panel is at the top of the screen. There's a menu launcher at the top left, a dock containing applications on the left and various settings icons and a clock in the top bar.

Despite the Gnome project's emphasis on simplicity, the desktop actually has a huge number of features, each of which can be fine-tuned to suit your needs. This lies at the very heart of the Linux experience and is why there are so many different 'flavours' of the OS available.

WONDERWALLS

When setting up Ubuntu, your first port of call should be to customise your desktop background. Right-click anywhere on the desktop and choose 'Change Background'. Gnome will then ask if you wish to change the wallpaper for the desktop itself (Background) or Lock Screen. Click the first option for now to scroll through the various default backgrounds available for Gnome. Select your desired one and then click Select at the top right to switch. If you prefer to substitute your own background, click the Pictures tab at the top of the Settings window. The files in your Pictures folder will be listed there. Click to highlight your chosen picture and then choose Select, just as you would for the default wallpaper. However, if you find the whole idea of snazzy wallpapers too distracting, click the Colours tab at the top of the screen. From here, you can choose a solid colour to serve as your desktop background.

CONFIGURING THE DOCK

By default, the dock is on the left-hand side of the screen and contains the icons for any running apps, as well as those you've pinned by adding to your favourites (right-click an icon to do this). If you've already changed the desktop background in settings, click Dock to configure options there. Click the rocker switch to auto-hide the dock when it comes into contact with other windows.

You can also use the slider to change the icon size from the default (48). Use the 'Position on screen' drop-down menu to alter the position of the dock on screen, for instance to the bottom.

ENHANCING WITH EXTENSIONS

Extensions (previously known as applets and widgets) are ways to enhance your Gnome Shell desktop. One such extension is Desk Changer, which supports cycling through various desktop wallpapers at set intervals, something which Gnome Shell can't do out of the box.

Visit **extensions.gnome.org** using Firefox to browse the various ways you can enhance your desktop. Follow the steps in the tutorial (see over the page) to start using extensions. While following the steps here, you can visit **extensions.gnome.org/local** at any time to browse extensions that you've already installed. Click the rocker switch next to an extension from on to off to disable it. You can also enable and disable extensions using the Gnome Tweak Tool (covered next).

MAKING TWEAKS

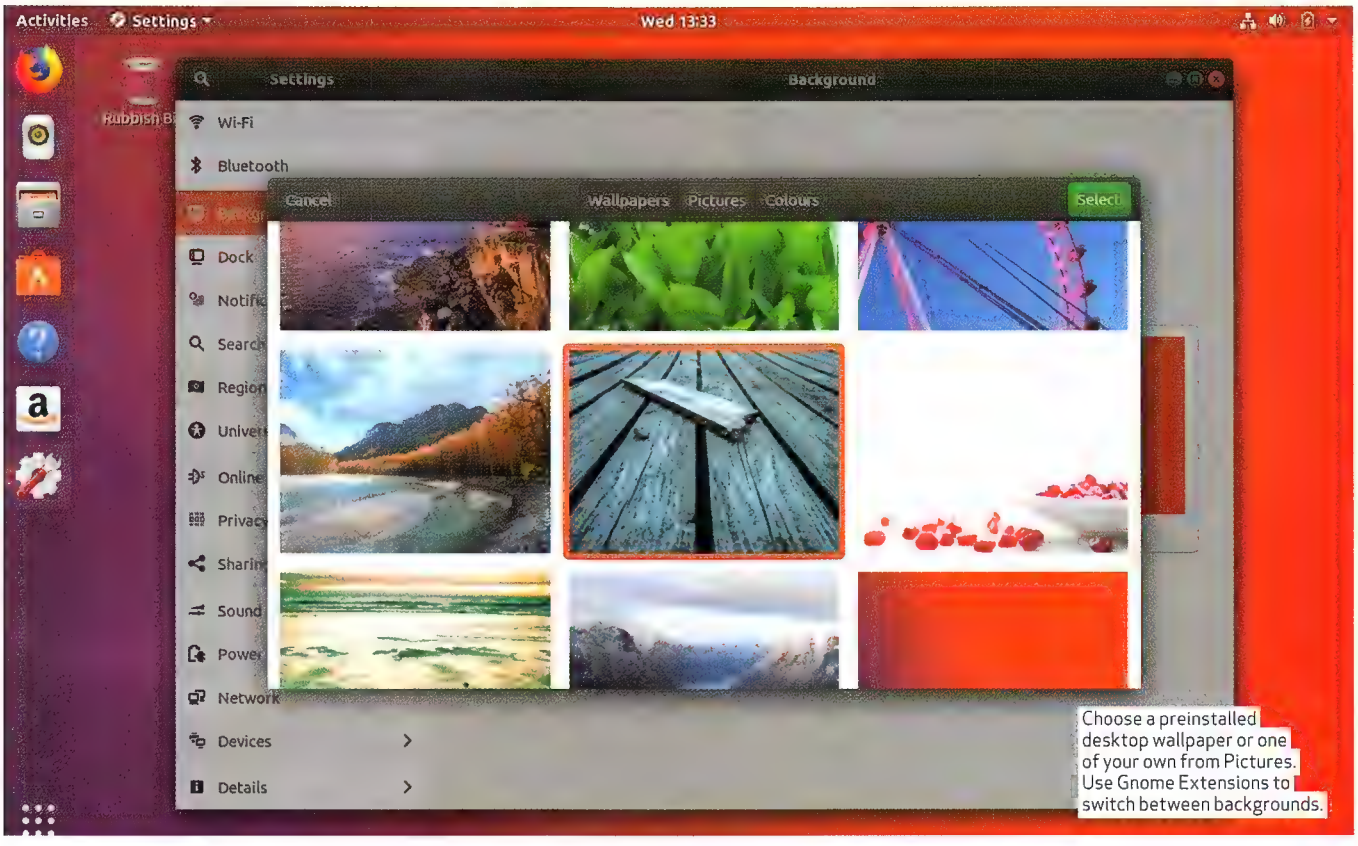
For those new to using Ubuntu 17.10, you may have noticed that the default desktop only contains the wastebasket icon. The Gnome Tweaks Tool is a powerful program that enables you to make a number of changes to your desktop interface, including adding more icons to your general clutter. To install it, launch Software from the dock and search for Gnome Tweaks in the search bar. Then click Install. Once the tool is downloaded, click Launch.

There are a number of configuration options here and we encourage you to explore them. For now, though, click Desktop. Mark the checkbox next to any icons you need, such as the Home folder or Network Servers. Return to the Tweaks menu and choose Extensions. This contains a small number of the extensions that are known to work with your system. The Ubuntu Appindicator Support Extension is designed specially for the OS and enables application indicators such as system updates to appear in the top bar. From here, you can also deactivate any extensions you previously installed via **extensions.gnome.org**.

WONDERFUL WORKSPACES

Gnome 3 makes it possible to manage running windows by managing various workspaces on your screen. These are equivalent to multiple desktops. You can see an overview of currently open workspaces by clicking the Activities launcher, then selecting it on the right-hand side. Any running

Virtually every aspect of your desktop can be customised from the theme used by Gnome Shell and windows, to your icons and cursor.



applications are displayed at the centre of the screen. Click these to launch.

Similarly, you can click a particular workspace and then on an application to place it there. This can be a little tricky to navigate at first, but with time, you'll see that this is actually a very efficient way to manage your desktop. There are also some tricks that you can employ to make using workspaces easier and more intuitive.

Because you'll likely be working with multiple workspaces, consider installing Workspace Indicator from the Gnome Extensions website. This places a number at the top right of each workspace, so you can easily switch between them. For instance, you might decide that Workspace 1 is for personal use, Workspace 2 is for business and so on. You can also click the workspace number to switch between them. There's also an extension named Auto Move Windows. Use this to make sure that certain applications always open on a particular workspace – for instance, the spreadsheet program LibreOffice Calc could always be sent to Workspace 2, which you've dedicated to business matters.

Relaunch the Gnome Tweak Tool and go to Extensions to alter the settings for this and other add-ons. Click the Settings icon next to an extension to make changes such as to add a rule about which applications should be opened in which workspace. By default, Gnome will create a new workspace each time you launch an app in a previously empty one. The desktop is designed to be efficient so this shouldn't weigh down your system resources too much. But if you find this hard to navigate, select the Workspaces category in Gnome Tweaks, then change Workspace Creation from Dynamic to Static. From here, you can also set the Number of Workspaces.

RAISING THE BAR

The latest version of Ubuntu includes Gnome Shell 3.26, which supports a translucent top bar out of the box. Select Top Bar from the Gnome Tweaks

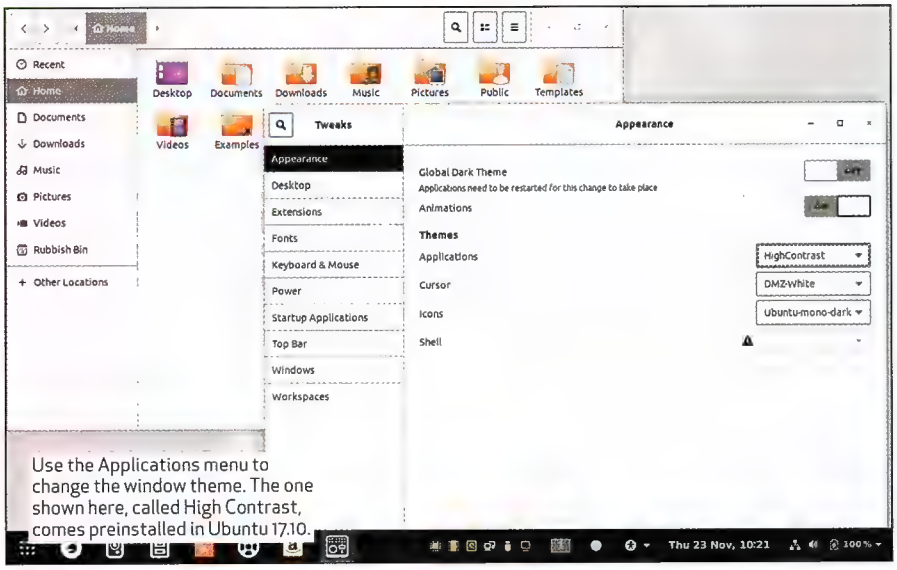
Get the lowdown with System Monitor

One of the most useful Gnome Shell extensions for your desktop is Géza Búza's System Monitor. Once installed on your machine, it displays a compact list of icons in your top bar, representing various system resources such as network usage, storage capacity and swap space. You can click these to view more detailed information about your system.

To get started, first click Activites at the top left of the screen and enter Terminal in your search bar. Double-click the Terminal icon to launch it. Enter the commands `sudo apt-get update` , then `sudo apt-get upgrade` to bring Ubuntu fully up to date. Next enter `sudo apt-get install gir1.2-clutter-1.0` . Choose 'Y' to confirm that you wish to install.

Once this is done, open your web browser and navigate over to **extensions.gnome.org/extension/1064/system-monitor**. Click the rocker switch to change it to its 'on' state. Save any work you're doing and then restart your machine.

When you next log in, you'll see the system monitor icons along the top bar just beside the clock. You can add or remove indicators, and change their alignment by opening the Gnome Tweaks tool. Go to Extensions and click the gear icon next to System Monitor. Use the rocker switches to disable individual icons — by default, they're all visible. Click the drop-down menu option 'position on top bar' to move the indicators to the left or right. If you install System Monitor, you may prefer to move the dock down to the bottom of the screen so that none of your icons are obscured by the bar.



Use the Applications menu to change the window theme. The one shown here, called High Contrast, comes preinstalled in Ubuntu 17.10.

menu to add the date and time in seconds to the clock. Laptop users can also see the percentage of battery they have remaining.

Other extensions such as System Monitor can display useful information from within the top bar. See the System Monitor boxout (on the previous page) for more information.

If you're coming to Ubuntu as a previous user of KDE or Windows 7, you may prefer to dispense with the Top Bar altogether. If you followed the steps in the tutorial to enable Gnome Shell Extensions, you can add Hide Top Bar which will keep it invisible while other windows are maximised to make better use of the space available on your desktop.

Alternatively, extensions such as Dash to Panel can combine your dock and top bar into a panel at the bottom of your screen, which may feel more familiar.

WORKING WITH WINDOWS

All programs native to Gnome use GTK+. This is a graphical toolkit that governs how applications are displayed. For a taste of what Ubuntu can do in this regard, reopen the Gnome Tweaks Tool and choose Appearance. Click the drop-down menu marked Applications to change from the default Ambiance theme to one of the pre-installed alternatives such as High Contrast.

If your appetite for snazzy windows has been whetted, close the Gnome Tweaks Tool, then open your browser and head over to Gnome Look (**www.gnome-look.org**). Click GTK3 Themes on the left-hand side. If you find a theme you like, scroll down the page to the Files section, where you should be able to download them in a compressed format such as ZIP. Once this is done, go to your Downloads folder, right-click the file and choose 'Extract Here'. The theme will appear in its own folder.

Next, you need to create a folder to store your themes. Open your home folder, right-click inside the window and choose to create a New Folder named '.themes'. Adding the full stop before the filename tells the system that the folder is hidden. This means it'll appear to vanish just after you create it. Press 'Ctrl-H' to reveal it. Copy the folder containing your chosen GTK Theme into .themes, then press 'Ctrl-H' again to hide it. Relaunch the Gnome Tweaks Tool and click the Appearance section once again. If your chosen Applications theme is compatible with Ubuntu 17.10, you'll now be able to select it in the drop-down menu.

GNOME SHELL THEMES

While installing GTK+ themes enables you to change the appearance of applications, Gnome Shell themes can be used to change the overall appearance of your desktop. You can install these in isolation, or in addition to extensions, window, icon and cursor themes.

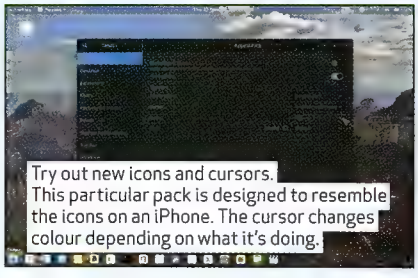
To get started visit **extensions.gnome.org/extension/19/user-themes** and install the User Themes Gnome extension. This enables you to store Gnome Shell themes in the .themes directory you created earlier in your home folder. Next, use your browser to visit **www.gnome-look.org** and choose Gnome Shell Themes. Make sure to read the description carefully because there may be icons or cursor packs that go with it. See the Fun with Icons box (below left) for help with this. Once you've downloaded the compressed Theme file, extract it to the .themes directory in your home folder, just as you did previously for the GTK+ files.

Close the Gnome Tweaks Tool if necessary, then open it once again. Click Appearance. Use the Shell drop-down menu to select your chosen theme. If the developers have suggested a particular GTK+ theme to use, too, install it and choose it from the Applications menu. If you're in need of inspiration, head back to the Gnome Look website. For instance, the machine in the image right uses the Flat Remix Dark Gnome Shell theme and icon pack as well as the equally sombre Deepin-dark GTK+ Theme.

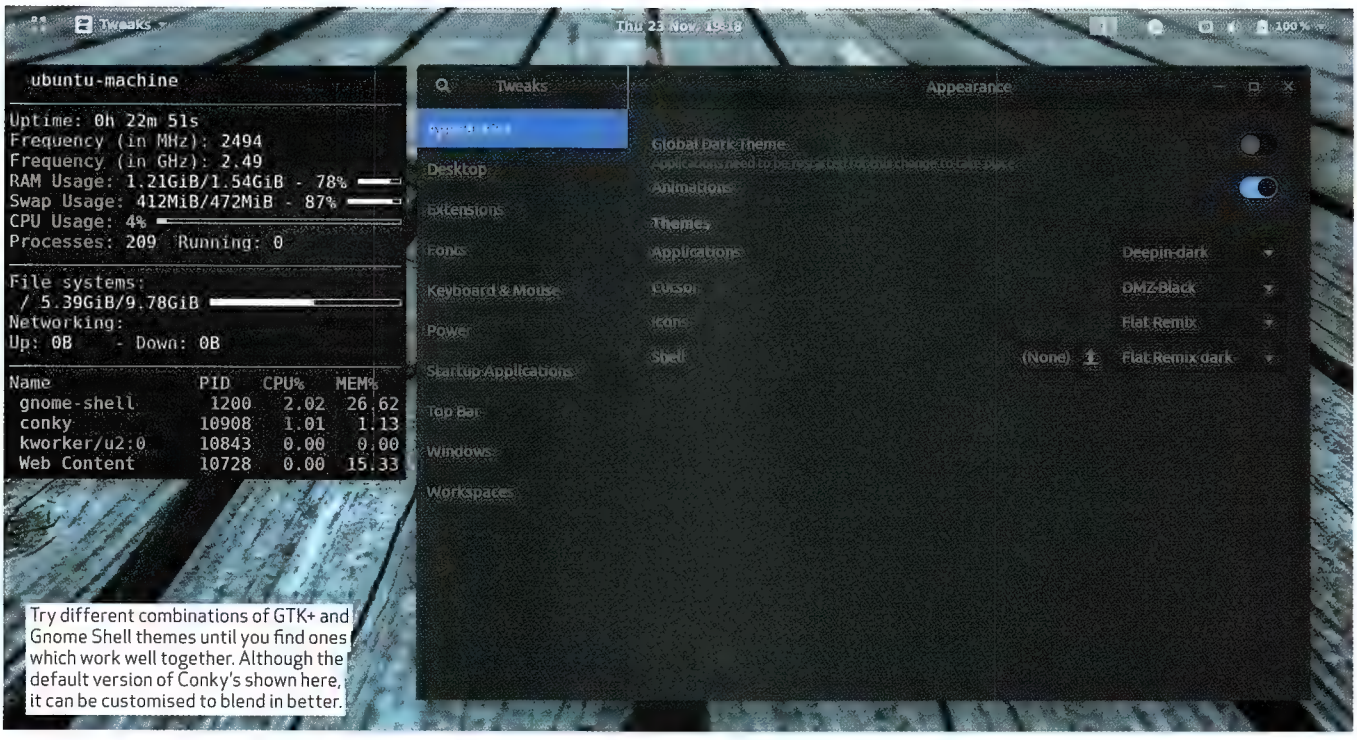
Fun with icons

Changing the appearance of windows won't affect the appearance of system icons and your mouse cursor. Fortunately, the Gnome Look website (**www.gnome-look.org**) has a huge number to choose from. You can install new icons and cursors in much the same way as for application themes. First, open your home folder, right-click anywhere inside the window and choose to create a New Folder named .icons. Despite the name, both icon and cursor sets are stored here.

Next, download your chosen icon and/or cursor pack and extract it to the new folder that you just created. Use 'Ctrl-H' to view the hidden .icons folder if you can't see it. Close and relaunch the Gnome Tweaks Tool if necessary, then go to Appearance. Your new icon theme and cursor will appear in the respective drop down menus. When it comes to icons, bear in mind that not all packs are created equal: there may not be a custom icon for certain programs or folders on your system. Similarly, certain cursor packs may not have images for every single scenario, such as scrolling or resizing windows.


Try out new icons and cursors. This particular pack is designed to resemble the icons on an iPhone. The cursor changes colour depending on what it's doing.

Take some time to experiment to find one that's suitable for you. Some icon or cursor sets may be designed for specific GTK+ or desktop themes. Make sure to read the description carefully before installing.



Try different combinations of GTK+ and Gnome Shell themes until you find ones which work well together. Although the default version of Conky's shown here, it can be customised to blend in better.

OVERTWEAKED

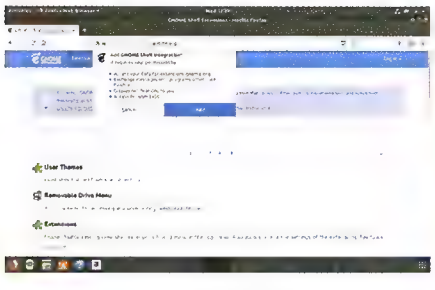
Adding extensions or new themes to your desktop doesn't change the core operating system itself, so customising your desktop is fairly risk-free. That said, if you do install any poorly coded extensions or themes, they may slow down your system or cause it to crash, so make sure to make a full backup of your work before customising Gnome further.

The System Monitor extension is useful for a quick glance at how your PC's resources are divided, it isn't very detailed. If you have multiple processors and drives and need detailed information on speeds, temperatures and so on, consider installing Conky. This handy app displays a basic text readout of all your key system attributes in a corner of your screen. To get started, open Terminal and run `sudo apt-get get install conky-all` to install Conky then run `conky &` to launch it. Conky can use a number of different icons and themes, which you can find under the Gnome Other category on the Gnome Look website.

Devoted readers may have noticed that all the steps in this guide involve interacting with and installing desktop items to your home folder. This means that any themes, icons, extensions or cursors won't affect other users on your machine. This leaves other people in your home or workplace free to set up their own workspace as they see fit.

If you've found that the new Gnome interface is simply not for you, considering using one of the many other flavours of Ubuntu such as Kubuntu which uses KDE, or Lubuntu which uses a custom version of the fast and lightweight LXDE desktop environment. You can download these as a DVD ISO, but you can install just the desktop environment from the Ubuntu Software app, then choose it from the login screen. You can find more information about this from the Ubuntu Forums official thread on supported desktop environments at **ubuntuforums.org/forumdisplay.php?f=329**.

Installing Gnome shell extensions

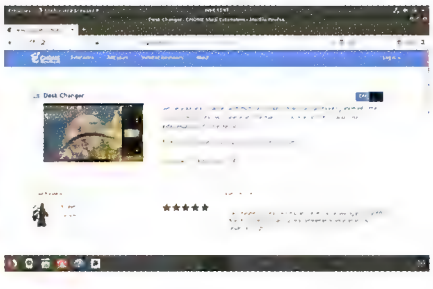


1 INSTALL FIREFOX ADD ON

Select 'Click here to install browser extension', and then click Allow on the pop-up notification. Finally, click Add in the pop-up marked 'Gnome Shell integration'. The add-on will install automatically. Minimise Firefox for now.

2 INSTALL HOST CONNECTOR

The site also requires a small program in order to offer the correct extension for your version of Gnome Shell. Click Activities at the top left of your screen and then type `terminal` in the search bar at the top. Double-click the Terminal icon, then type `sudo apt-get install chrome-gnome-shell` . Choose 'Y' to confirm.



3 INSTALL EXTENSIONS

Return to your browser and reload the page **extensions.gnome.org**. Run a search for your extension of choice or scroll the lists. If you find one you like, click it and then select the rocker switch marked Off to install it. The system will ask if you're sure that you want to install the extension. Click Install to continue.

Building a compact rig for QHD gaming

We combine ITX, Ryzen and a GTX 1070 Ti into a lovable little QHD-capable gaming bundle.

THE CONCEPT

Right, let's break this down quickly, and cover off the pain we suffered building it. In short, we forgot just how much hard work is involved when constructing a rig like this inside such a small case. There's a certain amount of anguish and scraped knuckles that goes along with building the miniature inside the tiny. And it's an accepted fact that it's going to hurt. Yet, despite this, ITX builds will always have an allure, an attractive enticement to any would-be PC enthusiast.

Why put yourself through so much torment – with cramped build conditions, frustration and more – to construct a system that would be just as at home in a mid-tower, as it would here? Well, two reasons.

Firstly, there's something intensely appealing about packing huge levels of performance inside a small enclosure. And secondly, we love a challenge. And that's exactly what the BitFenix Portal provides. That notion of saying to your buddies, "Yeah, I built this awesome rig, in that tiny case, and it performs incredibly." The potential pride is difficult to ignore.

The Portal, with its otherworldly design, is an intriguing case. Much like the Prodigy that came before it, the enticing lines and intricate styling almost entrance you, willing you into wanting to work it into something masterful. But it's a trap. Much like the sirens' song or Pandora's box, once your curiosity has been aroused, there's no going back. No return from the torment of this hell you've dragged yourself into. For the next however many years, it'll be both your beauty and your burden. And there's a quality in that, that's hard to come by in life.

OK, THIS ISN'T FUNNY ANYMORE

Once upon a time, this would have been a mid-range build. Can you believe that? If we take the 2016 prices for the GTX 1070 Ti, and th at 16GB kit of 2,666MHz memory, you'd be looking at a rig that would've cost about $2,300. At the upper end of mid-range, we'd argue. Not cheap, but pretty damn impressive. For that cash, you'd get yourself a machine that could hammer away at games at 1440p with ease, and dominate any rendering task you could throw its way.

So ignoring the current crazy pricing, let's talk specs for a bit, and pretend everything's fine. We mean, it is — right? Guys? *Right?*

We knew from the get-go that space was going to be a privilege in this build, so for storage, we decided that anything beyond 2.5 inches in size just wasn't going to work for us, regardless of what the Portal supports. We're still itching to get our hands on one of Seagate's 2.5-inch 2TB old-school hard drives with spinning platters, but Crucial's latest MX500 is a super-cheap, reliable 500GB SSD option that we can pop in here without worry.

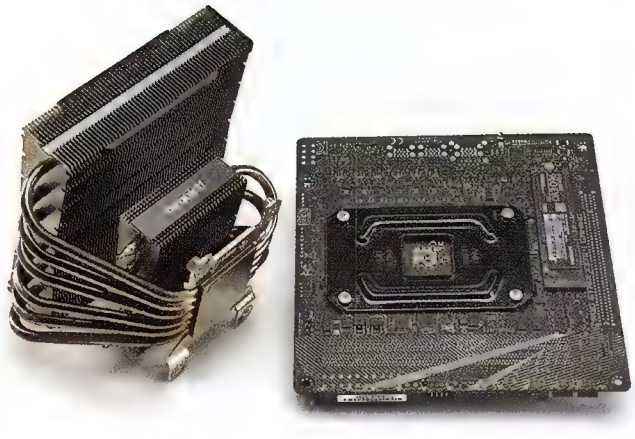
The one thing that caught us out was the lack of support for ATX power supplies. Our first build attempt with the Portal was a failure because we didn't realise this, and tried to fit the thing with a Corsair RM PSU. So to solve our mistake, we decided to grab one of Be Quiet!'s super-cute (no, seriously, they're adorable) SFX-L 600W modular PSUs. How the hell Be Quiet! managed to cram so much hardware into such a confined space is a mystery to us, but it's one brute of a small form factor PSU, capable of powering some gnarly rigs.

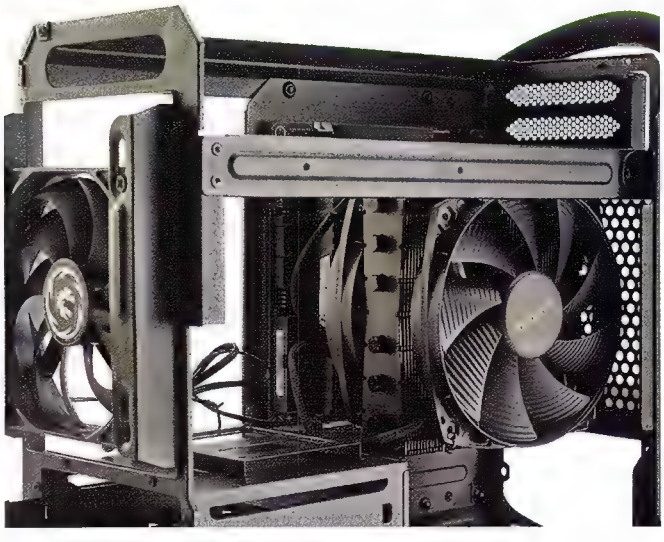
Speaking of Be Quiet!, we also decided to opt for its Dark Rock TF low-profile cooler. It's a tight squeeze, but the additional downward cooling should help alleviate Ryzen's brutish thermals, especially in the Portal, which is hardly brimming with intake airflow opportunities.

PARTS LIST

PART		STREET PRICE
CASE	BITFENIX PORTAL — BLACK	$240
MOTHERBOARD	ASUS ROG STRIX X370-I GAMING	$320
CPU	RYZEN 5 1600	$270
MEMORY	16GB (2 x 8GB) CORSAIR VENGEANCE LPX 2,666	$290
GPU	ASUS GEFORCE GTX 1070 TI ROG STRIX 8GB	$900
PSU	600W BE QUIET! SFX-L	$160
STORAGE 1	250GB SAMSUNG 960 EVO PCIE M.2	$175
STORAGE 2	500GB CRUCIAL MX500 2.5-INCH	$210
COOLING	BE QUIET! DARK ROCK TF LOW PROFILE COOLER	$99
OS	WINDOWS 10 HOME OEM	$133
TOTAL		$2,797

"For the next however many years, it'll be both your beauty and your burden."





1 BESPOKE BACKPLATES

Be Quiet! has never been known for its intuitively designed mounting mechanisms. Usually a pain to get to inside a chassis, we knew in advance that it was probably a smarter move to work with this one externally. Basically, you mount the backplate, push through four screws, clip them down on the other side, attach the mounting bracket to the cooler, then turn the cooler upside down, place the motherboard on to the cooler, and secure from the backplate, using a screwdriver. It's neat, if not a bit frustrating.

2 FITTING FRUSTRATION

And welcome to our first frustrating moment. In short, on first install, with the world's tightest fan clips, the motherboard simply wouldn't fit inside the chassis pod with the top fan installed on the CPU heatsink. Solution? Painstakingly remove the tight-as-hell fan clips from the top fan, pull it out (making sure to keep the fan plugged into the board), insert the motherboard, secure it down in place with screws, then slide the fan back in, carefully reclipping it back on to the heatsink, slicing your finger open at the same time. Win!

3 PSU PROBLEMS

Except, you don't do that. What you do is install the modular PSU first. Otherwise, you can't fit the PSU in after the motherboard is installed. And you'll have to repeat the whole process again. Twice. So remove the two 3.5-inch hard drive cages from the front caddy, slide the PSU into place — fan facing down for maximum airflow — secure it with a selection of screws, then install the motherboard.

4 GRAPHICS GRUNT

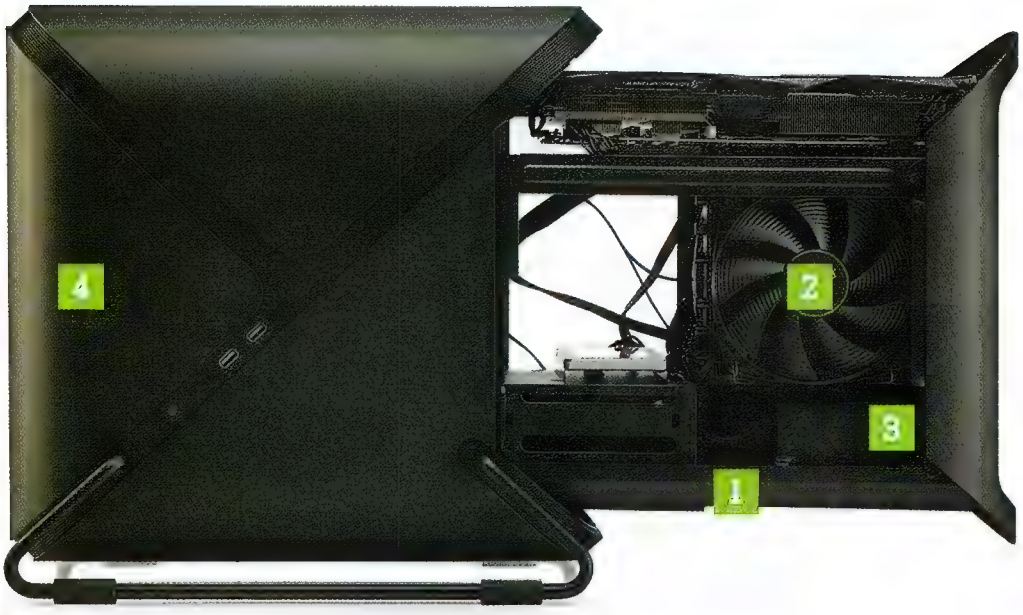
Once that's done, it's time to carefully start threading those PSU cables through the front bay, and connecting them to the motherboard. Make sure to leave one PCIe cable power out for the swanky GPU you'll be putting in next. To install this, remove the PCIe bracket guard on the back, take off the two covers, carefully line your GPU up with the PCIe slot, then, with a bit of effort and care, force it into place. You'll have to do this, because the two metal feet sticking out the bottom of the I/O plate on the back of the GPU have to slot into the extremely narrow and annoyingly positioned cutouts in the caddy itself, making it notoriously difficult to line up carefully.

5 CONNECTOR CONUNDRUMS

OK, so now we're getting to the end, surely it's not that bad? Think again! Front panel connectors — oh, yes. Take a quick look at Step 6, and you'll see just how tight a space you have to work with. Honestly, we recommend you skip the HD audio pass-through; you can remove it from the front I/O in the case, simply by pulling on the cable from the inside. It's not super-easy to install later if you do need it, but it's a connector that simply plugs in, so no worries. Then once that's out the way, carefully install the cables to the front I/O headers on the motherboard.

6 FINALLY FINISHED

And at last, the fun bit. Now you're all finished, you'll want to pick up your case pod, and carefully align the two notches on the bottom with the two holes on the sliding rail. Then carefully slide the pod back inside the chassis, making sure that you don't catch any of the cables on any of the fans littering the insides. Once that's all done, you're good to go. Power on, and hope that nothing's going to catch those fans.



1 This image is for decorative purposes only — never leave the fully equipped caddy extended on the sliding rail like this. You'll damage it.

2 Be Quiet!'s low-profile cooler is a godsend for this build. Its immense TDP leveraging potential keeps everything cool in a compact space.

3 600W of juice from a small form factor PSU? Madness. You could run a Core i7-7900X, GTX 1080, 32GB of DDR4, and 1TB plus 250GB M.2, and still have 200W spare.

4 You've gotta give BitFenix points for style — the Portal is simply stunning.

Beautiful but deadly

When all's said and done, this system is the purest form of awesome. No, seriously – despite how difficult it was to work with, despite the many cuts and bruises we suffered while building, benchmarking and diagnosing its predicaments, it has to be one of the nicest small form factor systems we've ever pieced together. Pictures really don't do it justice. It's only once you get inside and realise how tight everything is that its true genius comes to light.

It is equal to the sirens: deadly, but oh so beautiful. That said, there's a lot here that BitFenix could improve upon. Finding a way to install that power supply from the rear, for instance. Mounting the hard drive caddy so it's midway up the case pod, giving you room for cable management at the bottom. Bigger holes to allow an easier fit for those titanic GPUs. Better front fan intakes. And even some smarter cable management for that front I/O would have made this thing a dream.

It's difficult to design a chassis at this form factor, and the Portal is nothing if not exceptional in design. It's just lacking a few quality of life changes that would make it much easier to work in.

As for performance? Well, that's a mixed bag, too. Stepping outside of pricing for a moment, it's incredible. Stomping games at 1440p makes one happy gamer, and having the grunt to render video on the sidelines, too? Well, it can do anything. The SSD storage is exceptionally quick as well – load times feel almost instantaneous in places.

We did have trouble with that Samsung 960 Evo, though, with it seemingly having died since its last build, meaning another strip-down, and replacement with a spare. That aside, storage is as quick as you would expect from a budget PCIe drive from Sammy.

But now we do have to talk about the price, and it's a tough one to swallow – $900 for a GTX 1070 Ti, and a painful $290 more on memory. It's not a good feeling. A year and a half ago, that could have easily netted you double the memory and a GTX 1080 on top for the same price. Unfortunately, we no longer live in that world, and until Samsung, Micron, SK Hynix and every other semi-conductor company get their assets together, having to pay so much is one annoyance we'll have to endure for the time being. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	959	1,143 (19%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	1,721	1,688 (-2%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	1,473	1,430 (-3%)
RISE OF THE TOMB RAIDER (AVG FPS)	93	81 (-13%)
TOTAL WAR: WARHAMMER II (AVG FPS)	55	53 (-4%)
TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS)	48	43 (-10%)
3DMARK: FIRE STRIKE (INDEX)	9,128	8,817 (-3%)

Our *APC* Labs test PC consists of an Intel Core i5-8400, 16GB of Corsair Vengeance LPX 2666, an MSI GeForce GTX 1080 Armor and a 500GB Samsung 960 Evo PCIe SSD.

Pump up the music with a Raspberry Pi

Nick Peers reveals how to set up a Pi-based streaming music player that plays as well as it looks and sounds.

We're going to transform your Raspberry Pi into a music player with Volumio, a distro that has just one job: playing and streaming music. It's relatively easy to set up, is designed for headless use and provides a user-friendly interface through your web browser for managing your music. This UI is replicated on the official Volumio apps for iOS and Android, so you can run everything from your mobile, too. It costs $1.49 on iOS and $1.39 on Android, but you can access Volumio through your mobile browser, or try a MPD-capable app such as MPDroid for Android instead. Note, however, that MPD apps can be fiddly to set up (connecting using IP address rather than hostname is more reliable).

Volumio also doubles up as a UPNP/DLNA and AirPlay receiver, and can be used to stream music over the internet, with built-in support for web radio and plugins for streaming from Spotify and YouTube, too. Volumio supports the most popular audio file formats out of the box – including FLAC for those of us who have an aversion to lossy compression – and has native support for a wide range of I2S DACs for those who want to take their listening pleasure to the next level.

THE CABLE GUY

The basic equipment you'll need is your Raspberry Pi or Pi Zero, a 4GB or larger microSD card, and a cable capable of connecting your Pi to an amplifier or your home stereo system. First check the connections on the back of your amp – typically, this will be in the form of two phono sockets, in which case, you can connect your Pi's headphone jack to here using a suitable cable: 3.5mm plug at one end, and twin phono plugs at the other. If you can't source one locally, try **www.jaycar.com.au**. If you only have access to an HDMI port, then search for "HDMI audio converter".

If you want to take your music to the next level, then invest in a Digital to Analogue Converter (DAC) HAT for your Pi or Pi Zero. There are plenty of options out there. The box (on the next page) reveals how to source your own Pi Zero-powered audiophile-friendly music player for around US$90. The cost can be reduced dramatically if you're able to repurpose components like the Pi Zero W, power adapter or microSD card.

GET VOLUMIO WORKING

First, open your browser and visit **volumio.org/get-started** to download the Raspberry Pi build of Volumio. It's around 300MB compressed. Once done, follow the main step-by-step guide (over the page) to copy this to a blank microSD card (4GB or larger) and then complete the initial setup process. At no point will you need to connect your Pi to a monitor or keyboard – this is because Volumio is configured and accessed through any web browser connected to your local network.

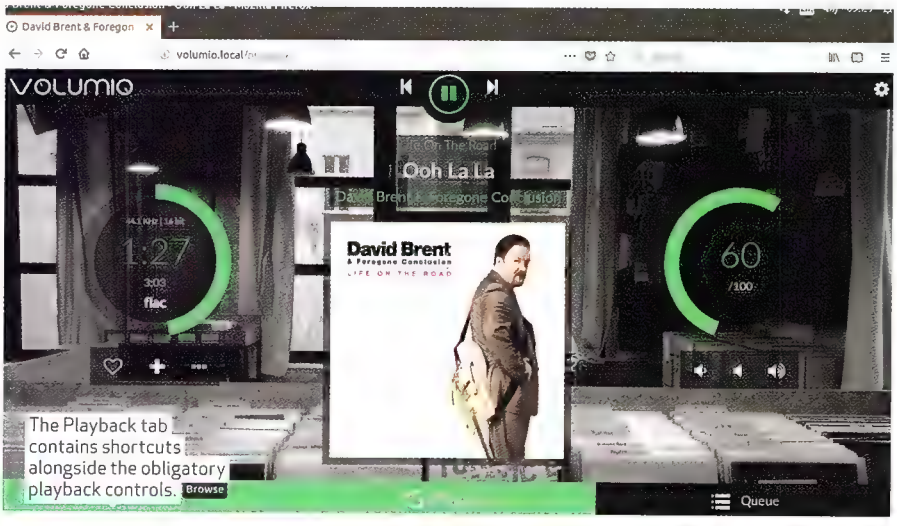
You'll be prompted during the setup process to select the folder where your music is stored. Volumio can handle multiple folders stored across a variety of different locations, including on the microSD card itself (you'll be looking to invest in a 64GB or even 128GB card if you go down this route, particularly if you're a fan of the audiophile-friendly FLAC format like we are). Because the SD format is prone to corruption, however, we'd recommend storing your music separately to Volumio. Suitable alternatives include USB storage plugged directly into your Pi – typically either a USB flash drive or a USB hard drive if your music collection is on the large side. If you're connecting to the Pi Zero, then you'll need a USB adaptor or shim, and furthermore, the USB drive will need to provide its own power.

A more convenient option is to connect to network storage, which is a good way to access music stored on your main PC or a NAS drive. Volumio will automatically look for network drives alongside any locally detected storage. Don't panic if your drive doesn't show up: simply enter its IP address or network name along with the path to your shared music library. Use Ubuntu's File Manager to determine its name and path if necessary.

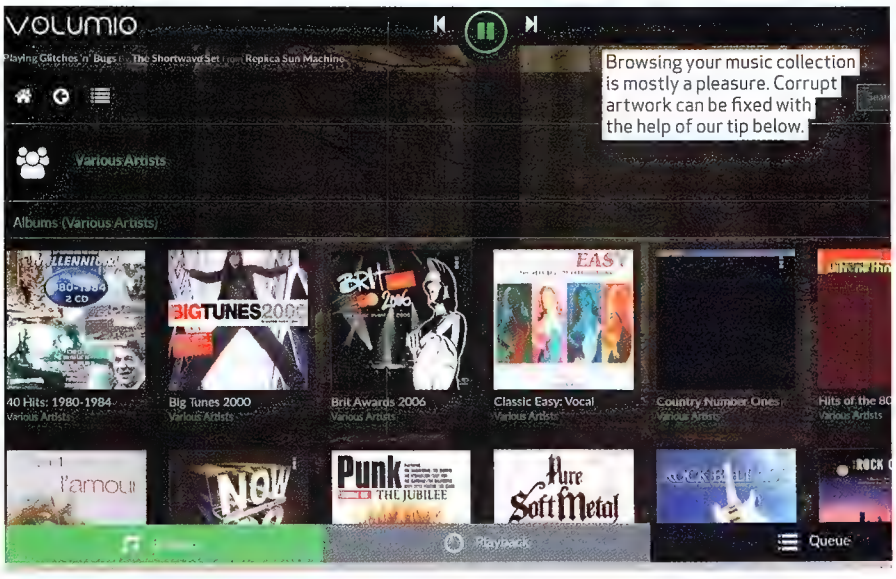
The initial scan will take some time, particularly on the Pi Zero and whether libraries are both large and stored externally. Once initial setup is complete, your browser should redirect you to the main Volumio playback screen. You'll see that it's split into three tabs: Browse, Playback and Queue. They're all self-explanatory, so start by clicking Browse where you'll see you can navigate your collection. Look out for the spinning wheel at first. This indicates that your folders are still being scanned for content.

CONFIGURATION OPTIONS

While you wait for the initial scan,



The Playback tab contains shortcuts alongside the obligatory playback controls.



click the Settings button in the top right-hand corner of the Volumio window to find a range of configurable options. Start with My Music, where you can add new drives to your library. You can also tweak other preferences here, such as whether to download album art from the web, for music folders without art in them. Consider switching this off if your album art is embedded directly into each music track (you'll also need to flick the 'Show Embedded Albumart' switch on and then click the 'Reset Album Art Cache' button. If you find that certain artwork comes up missing or corrupt, browse to the album folder in File Manager, select 'View > Show hidden files' and then delete the hidden .jpg album art files. Once complete, go to 'Settings > My Music' and click 'Reset Album Art Cache > Rescan' to update the album art.

Select 'Playback Options' to change your output device and adjust related settings. Explore Playback Options if you experience frequent buffering when listening to music over the network. Increase the 'Audio Buffer Size' to 12MB and consider upping the 'Buffer Before Play' figure. You can tweak Volumio's volume options from here, too, such as setting a default volume on startup or limiting the maximum volume level.

The Appearance settings affect the web (and Volumio app) interface, enabling you to change language, select a background image (or upload your own) or choose a plain background colour. Access Network Settings to configure the wired and wireless interfaces – typically to establish a static IP address. You can disable the built-in Volumio Wi-Fi hotspot from here for security reasons. Furthermore, there's an option to choose different DNS settings if you're struggling to get internet access, such as those offered by OpenDNS (208.67.222.222 and 208.67.220.220).

Select System to re-run the first configuration wizard, change your player name (handy if you have more than one Volumio-based music player), perform a factory reset, delete your user data and check for updates. A word of warning about this final option: it may corrupt your SD card, so back up any user data on the card before you begin. We'll tackle this at the end of this project.

Once backed up, open Volumio and switch to the Browse tab. You'll see several options for browsing your library: you can navigate by artist, album or genre (if your files have been correctly tagged), or choose Music Library to browse by location. This comes in handy if you've set up multiple folders and are only interested in browsing a specific one (for example. your classical music collection).

Over time, your music folders will change, of course. You'll add new tracks and perhaps remove others. You may also wish to manage the metadata associated with your tracks – both tags such as artist, track name, album name and so on, together with artwork. None of these changes are automatically recognised by Volumio; instead, you'll need to manually rescan or update your library. The difference is straightforward: update searches for new, changed or removed content, while rescan scans all the files in your library for changes.

If you've updated a specific artist or album then you'll also find a handy 'Update Folder' option on the three horizontal lines menu (≡) next to its entry. This enables you to perform a focused scan on that part of your library.

BROWSING AND MANAGEMENT

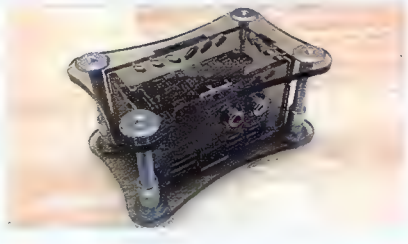
You'll also see options for browsing by Favourites and Playlists. Favourites contains a list of your best-loved tracks – these can be added manually via other views (or the queue tab) by clicking the 'hamburger' button next to a track and choosing 'Add to Favourites'. Once added, just click the burger button again and choose 'Remove from Favourites' when you become sick of listening to the song.

Playlists offer more flexibility, as you can generate these from entire albums and even artists as well as individual tracks – see the box on the following page for more information on managing playlists.

Two final options include 'last 100', which basically lists the most recently listened to tracks. This is a convenient way to quickly collate these into one place for the purposes of creating a playlist or favouriting specific tracks. Then there's 'Web Radio', which gives you access to hundreds of online streaming radio stations.

Build your own player

volumio.org offers several pre-built Pi-based music players, but given the cheapest weighs in at around US$120 — without a Raspberry Pi — we thought we could do better. Here's your shopping list:



FROM THEPIHUT.COM	
PI ZERO W	US$22
GPIO SOLDERLESS HAMMER HEADER	US$5
5V POWER SUPPLY	US$7
DELIVERY	US$5
FROM WWW.ADAFRUIT.COM	
PI-DAC ZERO	US$15
PI-CASE	US$10
16GB MICROSD CARD	US$10
DELIVERY	US$10
FROM WWW.EBAY.COM	
M OFC TWIN PHONO TO PHONO JACKS	US$10
TOTAL	US$90

Working with playlists

Like any good music player, Volumio supports playlists, but unfortunately, it's not the most intuitive of tools. Switch to the Browse tab and then browse your music library by either artist or album. You'll see the 'hamburger' button next to artists, albums and individual tracks — click this and you'll see an option to add the selected item to a playlist. Either type the name of a new playlist and hit New, or click an existing playlist to add the items to it.

You can access your playlists from the Browse tab. From here, you can open the playlist to remove individual items via the hamburger button, but one crucial missing feature is the fact that you're unable to rearrange the running order.

No problem: a more elegant — and indeed, quicker — method to both create and edit playlists comes curtesy of the Queue tab. Instead of adding items to a playlist, choose 'Add to Queue' instead (so one click instead of two).

Once complete, switch to the Queue tab. Not only can you remove individual items from here, you can click and drag them to rearrange them, too. Then click the floppy disk icon to create a new playlist or select an existing one.

Note that your queued items aren't appended to an existing playlist — they'll overwrite it. So if updating a playlist, you should first select it from the Browse tab (under Playlists) and choose 'Add to Queue' before making your changes.

ONLINE STREAMING

Web Radio utilises Shoutcast and Dirble services for tracking down and listening to radio stations worldwide. Shoutcast offers a choice of the top 500 radio stations or the ability to browse by genre; Dirble offers a browse by country function. Click a radio station to start listening, adding it to the queue or make it one of your Radio Favourites.

You can also manually add radio streams yourself by clicking ≡ next to 'My Web Radios' and choosing 'Add Webradio'. Give your stream a name, then enter its URL stream or link to M3U or PLS remote file. Most people want to add radio to their lists — you can find a handy list of all the Australian Broadcasting Corporation's direct streams (which are PLS files) at **http://radio.abc.net.au/help/streams**, which includes triple-j and all the regional capitals. Other broadcasters (both local and international) also often provide direct streams, so it's worth having a hunt for any you'd like to listen to. Once you've populated your list with all the stations, you can click My Web Radios to listen to them.

Two additional streaming services — Spotify (Premium account required) and YouTube — can also be added via 'Settings > Plugins > Search Plugins'. Once installed, switch to the Installed Plugins tab to switch them on. You can then access them from the home screen under Browse and access the content as if it were your local library, adding it to queues, playlists and favourites (a handy search tool helps you to quickly locate content). The major difference between local music and streaming is the noticeable delay between clicking on a stream and it actually starting.

BEYOND THE BASICS

Plugins enable you to extend what Volumio can do. There are currently around 10 available from Volumio's Plugins, split into four categories. Spotify and YouTube are currently the only additional Music Services on offer from here. For more plugins, check **bit.ly/volumio-plugins**. Drag and drop the ZIP file to the Uploaded Plugin tab. Note: they can be glitchy.

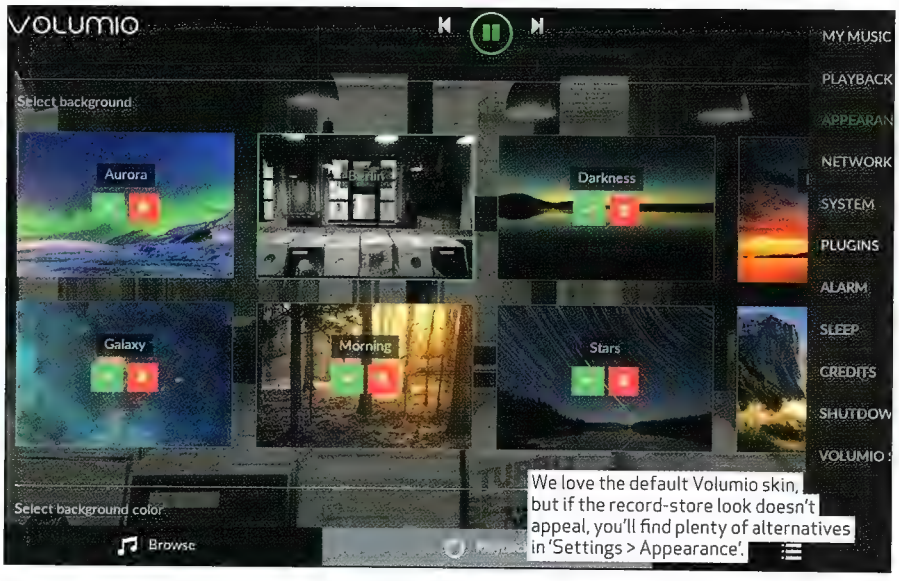
The Miscellaneous and System sections include five plugins that extend support to various hardware add-ons. Of most interest will be the Touch Display Plugin for those who've hooked up their Pi to any touchscreen display (it's optimised for the 7-inch Raspberry Pi display), plus GPIO Buttons, which enables you to control basic playback buttons through physical buttons.

The Accessories section contains an IR Remote Controller plugin for controlling Volumio playback via remote control. It's configured for JustBoom IR Remotes, but also offers profiles for Odroid Remote and Apple remote, too. Don't forget that you'll need an IR receiver for your Pi.

The final plugin should be considered essential: Backup & Restore Data. Once installed, switch to the Installed Plugins tab to activate it, then click Settings where you choose what to back up. Your available options are Playlists, Favourites, Configuration data, Queue and Album Art. Click Backup and a file called 'volumio_data.tgz' will be saved to Volumio's shared folder.

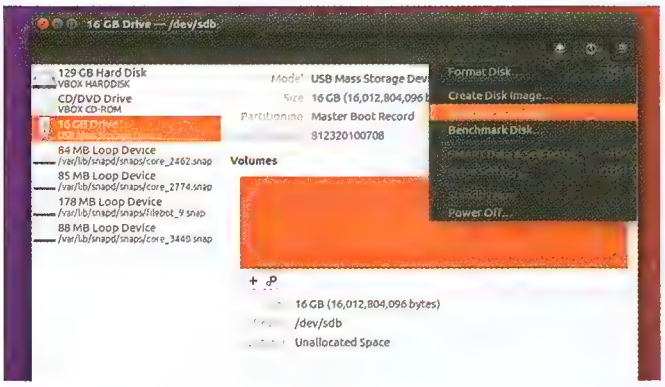
Once saved, go into File 'Manager > Network > VOLUMIO > Internal Storage' — log on anonymously when prompted, then save volumio_data.tgz to a secure location. After restoring Volumio and reinstalling the plugin, be sure to copy this file back to the root directory of Internet Storage, then click the Restore button to put things back in place.

You can use the Backup and Restore plugin to do more than simply provide a fail-safe in case of SD card corruption; you can also use it as a crude snapshot tool. About to make a major change to your database? Take a backup and then simply restore it if things don't go to plan.



We love the default Volumio skin, but if the record-store look doesn't appeal, you'll find plenty of alternatives in 'Settings > Appearance'.

Set up and install Volumio

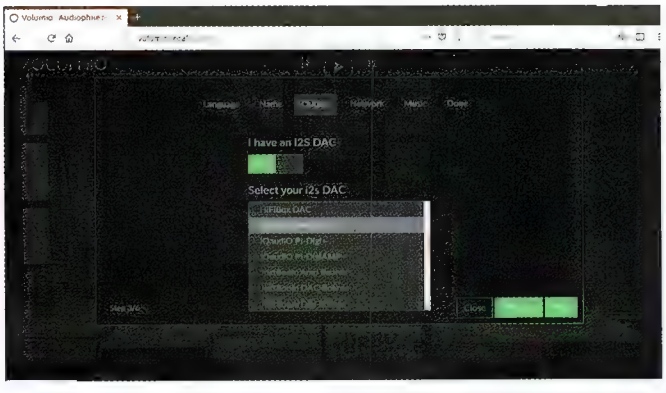


1 PREPARE YOUR MICROSD CARD

Double-click the .img.zip file you downloaded from the Volumio website to open it in Archive Manager. Click Extract and save the image file to the same directory as the downloaded file. Now insert an unused microSD (4GB or larger) card into your PC. Open the Disks utility, select your card and click the hamburger-like icon. Choose 'Restore Disk Image...'

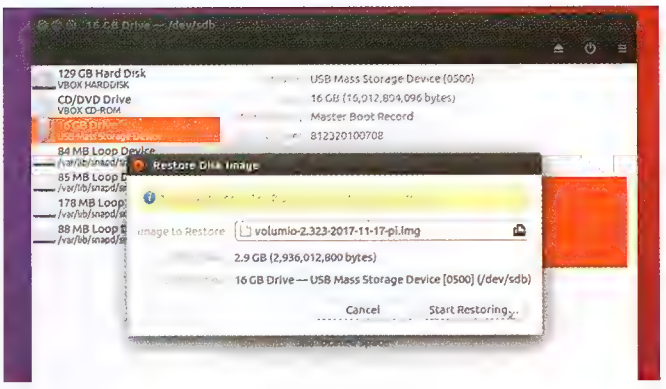
3 SET UP VOLUMIO

Once complete, verify the volumes are set up correctly: a small 64MB FAT32 bootable partition, plus a 2.4GB volumio Ext4 volume followed by a 300MB volumio_data Ext4 volume, with the rest of the drive given over to (for now) free space. Safely eject the card again, then insert it into your Raspberry Pi and switch the power on. Wait for around 6–10 minutes while it's set up and the free space allocated.



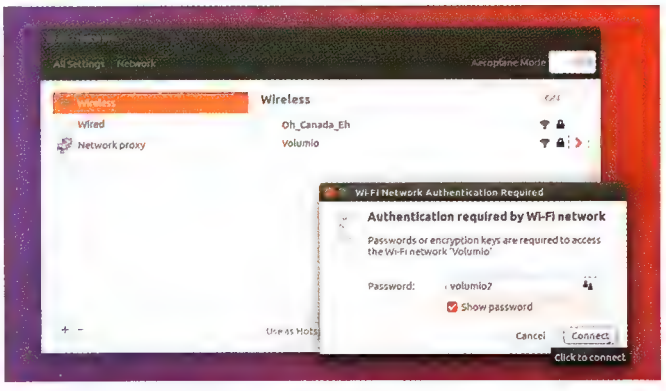
5 NAVIGATE FIRST-RUN WIZARD

A six-step wizard helps you get things up and running. First, select your language and click Next. Give your device a unique name (in most cases 'Volumio' will be sufficient unless you have multiple devices set up) and click Next again. Then choose your output device. Flick the I2S DAC switch to Yes, then select it from the list and click Next again.



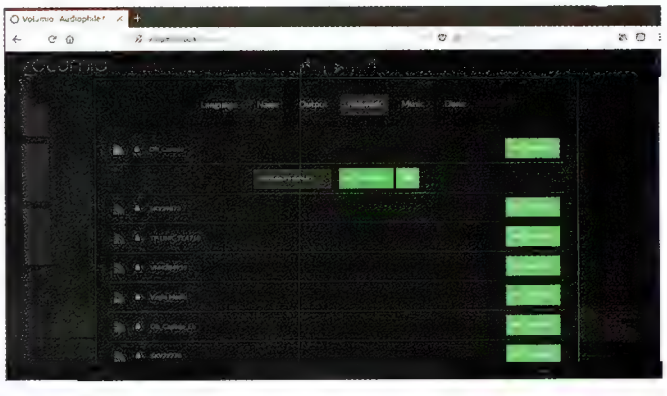
2 INSTALL VOLUMIO

Click the None button to browse for and select your image file. You'll receive a warning about the disk image being smaller than the target device — don't worry, Volumio will expand the partition during setup. Click 'Start Restoring...' followed by Restore. Enter your user password, then sit back and wait for the image to be written to the card. Once complete, safely eject the card.



4 SET UP CONNECTION

If your Pi is going to connect wirelessly to your network, you'll need to first connect to its own internal Wi-Fi network via another wireless device or computer. Open the device's network properties: 'Settings > Network > Wireless' in Ubuntu — and connect to the Volumio Wi-Fi network — use the password 'volumio2'. Now open your browser and go to **volumio.local** to set things up.



6 COMPLETE SETUP

Now connect Volumio to your Wi-Fi network. Select your network from the list and click Connect. Enter its password (ignore the warning about insecure connections — we can fix this later). Click Next. You'll be prompted to set the path to your music collection — click 'Add New Drive' to do so. Finish by clicking 'Next > Done'. Reconnect your PC or device to the main network.

Huawei's Mate 10 Pro includes a Neural Processing Unit for faster AI.

Smartphone 2.0 is coming

Tomorrow's Android devices are powered by new processor chips being released now. Darren Yates looks at how these chips will drive our pocket portables over the next five years.

When the iPhone first hit the market in 2007 and the HTC Dream Android phone arrived the following year, they were quickly dubbed 'smartphones' for their ability to do more than just make phone calls. But with 'smart' technology now applied to almost everything from TVs to fridges, smartphones don't seem as especially smart any more.

However, according to market research firm Gartner, smartphones are about to take 'smart' to the next level. In 2017, 10% of smartphones feature artificial-intelligence (AI) capabilities. By 2022, that proportion is predicted to top 80%. Still, as we've said before, if you want to see what's coming in future phones, just look at what's happening with System on a Chip (SoC) processors today and you'll get a good idea.

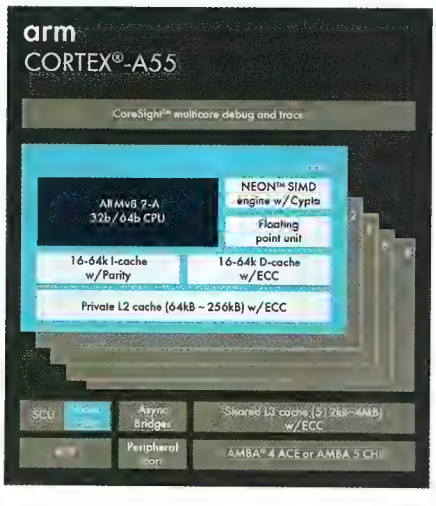
NEW ARM CORTEX A-SERIES

The smartphone computer chip market these days is all but owned by CPU designer-to-the-stars, ARM Holdings. The company, which designs the core architecture appearing in almost every smartphone chip, was taken over by Japanese giant SoftBank in a massive US$32 billion deal in 2016. It continues to develop the base-line processor technology that will run next-generation smartphone chips, the latest of which, include the upcoming flagship Cortex-A75 and mid-range Cortex-A55 cores.

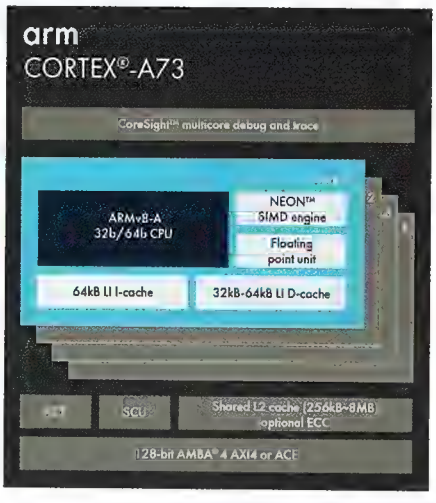
ARM CORTEX-A75

The new Cortex-A75 will take over from the previous flagship core, the Cortex-A73, which probably hasn't been used as much as we might've expected — so far, the only known examples of A73 implementation are HiSilicon's Kirin 960 and 970 SoCs, plus the MediaTek Helio X30. Chipmaker Qualcomm reportedly used a modded Cortex-A73 in the Kryo 280 core inside its top-drawer Snapdragon 835 SoC CPU, making it arguably the A73 posterchild — it powers the likes of Samsung's Galaxy S8 phone series, the Google Pixel 2 range and LG's recent V30.

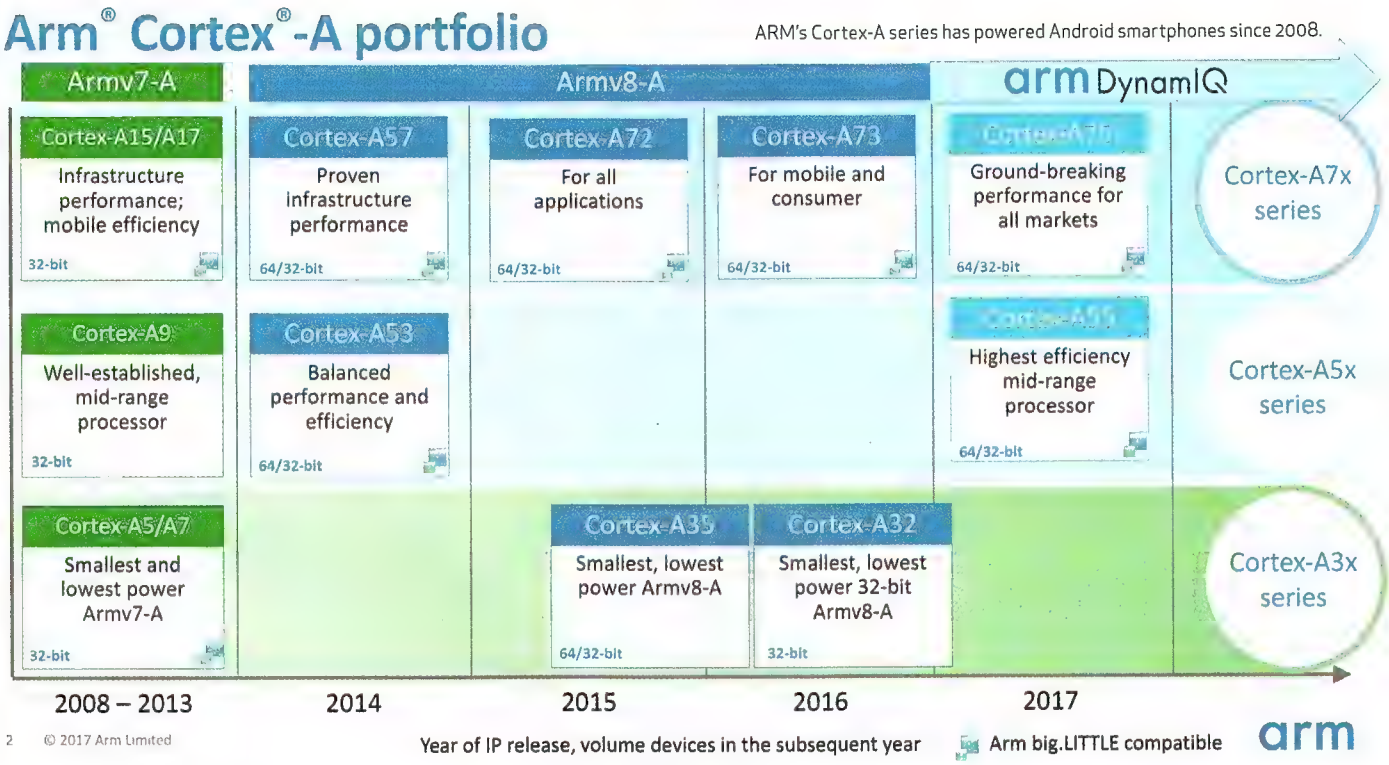
ARM expects the A75 to deliver up to 48% more performance than the A73, which includes a 22% boost in single-thread performance and a 33% spike in floating-point speed. One significant way this is achieved is with the arrival of dedicated core L2 cache. In the previous-gen Cortex-A73, each core received dedicated L1 cache (up to 128KB), but L2 cache was shared. You could have up to 8MB of it, but the bus-sharing meant it took 20 clock



The Cortex-A55 replaces the popular A53 and supports up to eight cores.

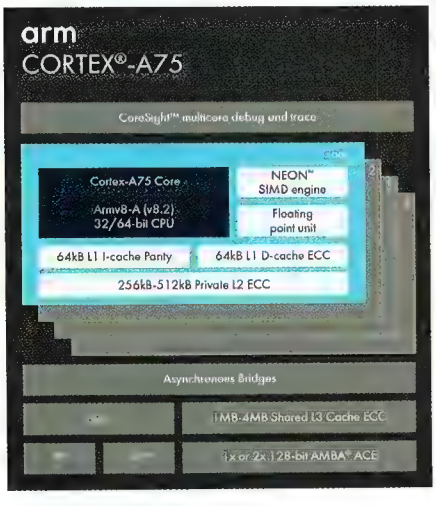


The Cortex-A73 doesn't have exclusive core L2 cache — the A75 does.



cycles to get access. The Cortex-A75, however, provides either 256KB or 512KB of private L2 cache per core (chipmaker's discretion) and up to 4MB of new shared L3 cache. As a result, L2 cache latency reportedly drops down to 11 clock cycles. The total cache capacity now appears to be less (6MB vs 8MB), but more efficiently implemented.

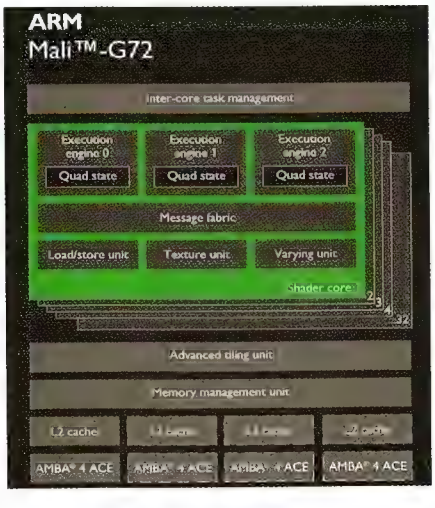
Just before Christmas 2017, Qualcomm announced the new top-drawer Snapdragon 845 SoC, featuring eight new Kryo 385 cores, four topping 2.8GHz and another four 'making do' with 1.8GHz. The Kryo 385 core is reported to be a modded Cortex A75, 25% faster than the previous-gen offering. The Snapdragon 845 also adds in a new Adreno 630 GPU, packing in 30% more performance with 30% less power draw.



The flagship Cortex-A75 supports up to four cores per cluster usage.

ARM CORTEX-A55

The new Cortex-A55 core design will replace the incredibly popular Cortex A53, which runs just about every sub-$400 phone on the market at the moment (as well as the Raspberry Pi 3 computer board). The A55 will support between one and eight cores in a single cluster (up from the A53's max count of four) for mobile applications and operate in multiple clusters (usually reserved for server use). The A55's major selling points are 18% more performance at 15% less power consumption compared with the A53. Again, as with the A75, the A55 gets exclusive 'per core' L2 cache, this time up to 256KB per core, but shares a similar 4MB-max L3 cache. With phones like the Motorola Moto G5 receiving plenty of kudos in 2017, we expect to see a similar setup with octo-core Cortex-A55 chips and hopefully Android 8.0/Oreo this year.



The Mali-G72 supersedes the G71 with improved machine-learning.

ARM SCALE

If you find all the various Cortex monikers a bit confusing, we've found a couple of slides that show the scale of ARM processors across the market segments. The first (above) gives you a quick history of how the phone SoC world has developed since 2008, starting with the low-end Cortex-A7 and A9 designs, progressing to the Cortex-A15 and A17, then on to the 64-bit architecture provided by the ARMv8-A family, starting with the Cortex-A57 and A53.

The other slide (over the page) shows a more complete ARM Cortex lineup across different industries – the Cortex-A series powering smartphones, tablets and high-end development boards, while the Cortex-R series ('R' for 'real-time') is used to drive wireless modems and for real-time applications. Putting my 'Arduino Masterclass' hat on for a second, the Cortex-M series are microcontrollers, self-contained chips that include CPU, RAM and flash storage. The flash storage holds code that typically runs without the need for an operating system. The Cortex-M0 and M3 SoCs are available in Arduino-grade boards.

One difference with ARM is that, unlike Intel or AMD, where a new chip series all but replaces the previous version, ARM's previous generation cores are technically still available to anyone wanting to sign up for a licence to make them.

ARM MALI G72

Tying the Cortex-A75 and -A55 designs together is a new-gen graphics processor unit (GPU) called the Mali-G72 to supersede the previous G71. The G72 is the first second-generation Bifrost-architecture GPU, offering up to 25% improvement in energy efficiency and as much as 40% more performance than previous-generation chips – that includes an improvement of 17% more efficient machine-learning. It'll be scalable from one to 32 cores and have wide-ranging application programming interface (API) support, including OpenGL ES up to 3.2, OpenCL to 2.0 and DirectX 12. It's HDR-ready and will support 3D imaging.

It's unlikely you'll see it in any Qualcomm Snapdragon-based devices, but on the basis of the Galaxy S8, we half-expect to see the G72 inside the next-generation Galaxy S9 phone sold in Europe, the Middle East and Africa (EMEA) regions, thanks to its probable use in Samsung's next flagship Exynos SoC.

The first chipmaker we know to feature the G72 is Huawei-spinoff HiSilicon. It's already flagged to include a 12-core Mali-G72 setup inside its up-coming Kirin 970 SoC.

AI ON THE RISE

Gartner's predictions for smarter smartphones are pretty much backed up by these new SoC cores from ARM. One of the key features for previous-generation ARM chips was big.LITTLE, the technology that allowed two different classes of CPU core to operate together, high-performance cores for speed and lower-performance cores for greater efficiency. Now, ARM is replacing big.LITTLE with the next-gen architecture called DynamIQ. Apart from allowing greater flexibility in the choice of core combinations chipmakers can fuse together into a chip, DynamIQ is also expected to deliver a 50-times increase in artificial-intelligence performance over the next five years. That's not 50%, but 50-times the performance – thanks largely to the ability of chipmakers to incorporate AI accelerator cores inside a SoC, similar to how MPEG-4 video benefits from hardware acceleration for video decoding. With that level of performance increase, it's easier to see how the future of smartphones will evolve.

KIRIN 970 AND SNAPDRAGON 845

Phone maker Huawei announced the Kirin 970 back in September 2017, and while it looks set to be the first SoC to feature the Mali-G72 GPU, it'll also include a 'neural processing unit' (NPU), a machine-learning hardware-accelerator. Huawei claims the NPU's performance on image recognition is roughly 20 times faster than the on-core CPU's ability alone. In general, it's said the NPU can achieve 25 times the performance and 50 times greater power efficiency. What's more, it doesn't even use the Cortex-A75 core, just previous-gen A73 tech. The Kirin 970 will arrive in Huawei's newly released Mate 10 Pro phone.

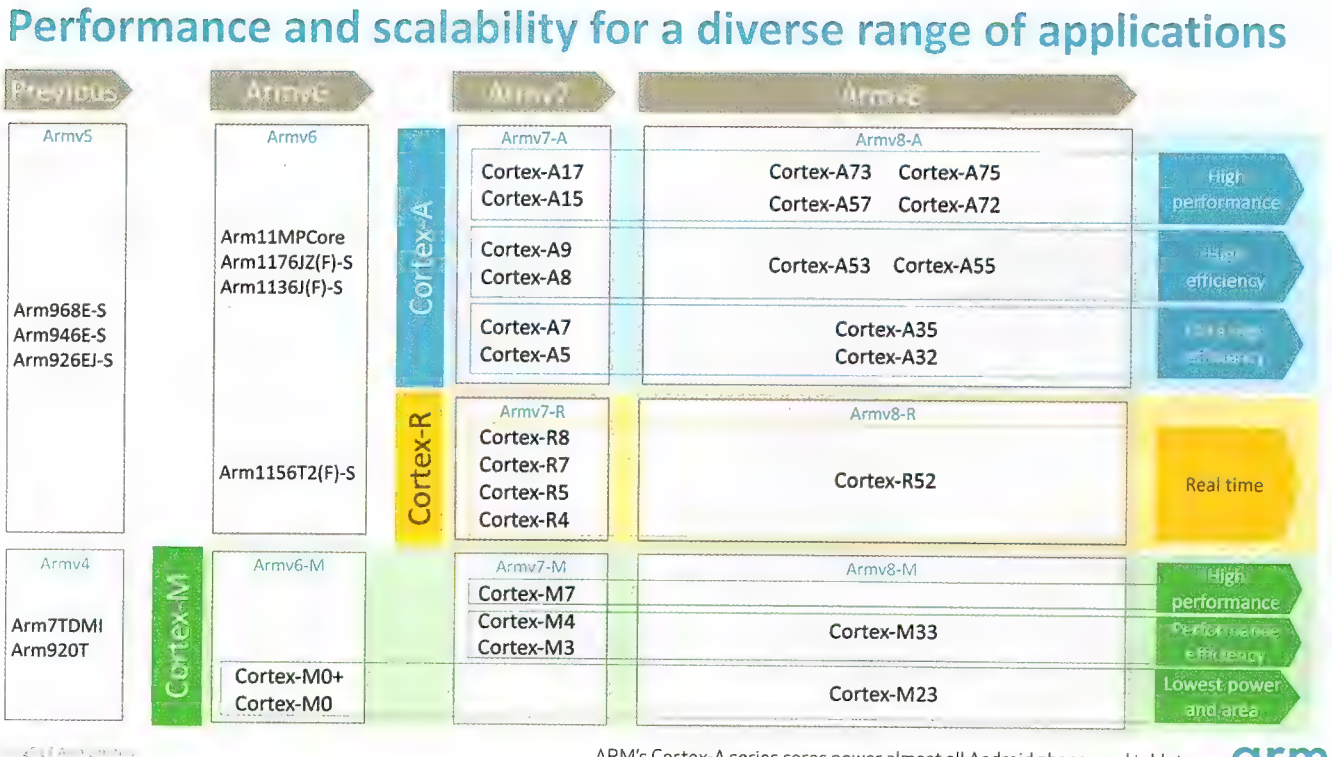
Qualcomm's new Snapdragon 845 will make use of a new Hexagon 685 co-processor for machine-learning and image processing, delivering three times the AI speed of the previous-gen Snapdragon 835's Hexagon 682 processing core.

The follow-up to Samsung's Galaxy S8 could feature the new Mali-G72 GPU.

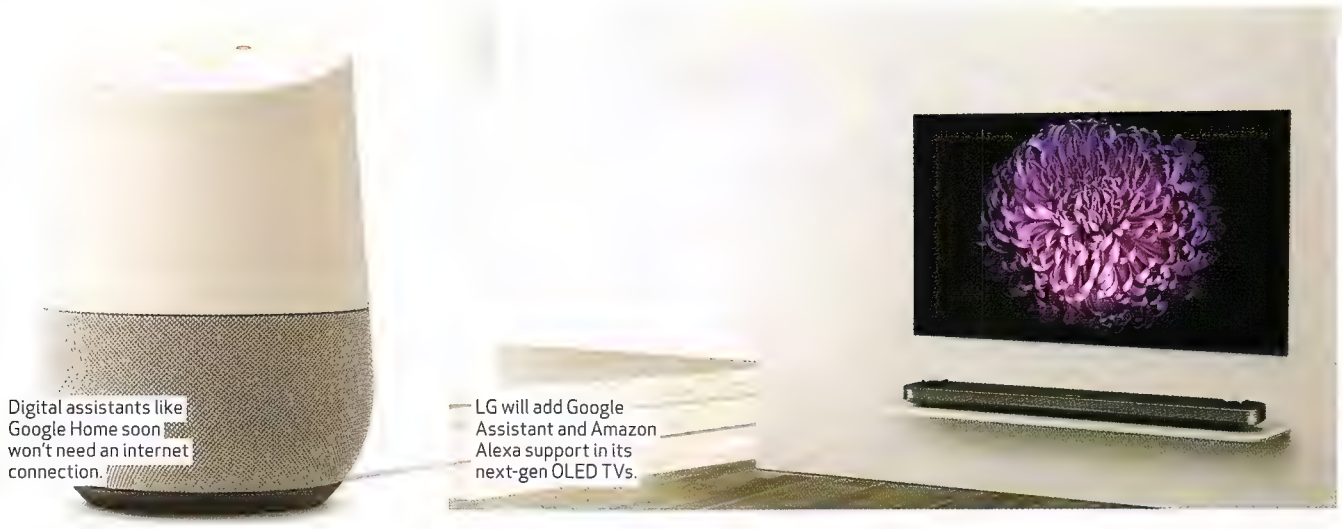
TEN APPLICATIONS FOR FUTURE AI

Market researchers Gartner, in coming up with their 80% prediction, also found 10 application areas where mobile AI is expected to have a major impact –

- 'Digital Me' (more on this concept opposite),
- User authentication,
- Emotion recognition,
- Natural-language understanding,
- Augmented reality and AI vision,
- Device management,
- Personal profiling,
- Content censorship/detection,
- Personal photography, and
- Audio analytics.



ARM's Cortex-A series cores power almost all Android phones and tablets.



Digital assistants like Google Home soon won't need an internet connection.

LG will add Google Assistant and Amazon Alexa support in its next-gen OLED TVs.

The 'Digital Me' concept looks set to take the 'personal digital assistant' model and put it on steroids. Instead of just remembering dates, Digital Me will initiate actions. Gartner gives the example of a connected home, where Digital Me could start a vacuum bot or your rice cooker before you get home. Presumably, it could even start the coffee machine just before you wake up. It could also potentially replace passports for travellers.

User authentication is becoming a major issue – we're generating more passwords than we can remember, fingerprints and eyeballs can be pwned. By a mixture of machine-learning and phone sensing, devices will aim for 'frictionless authentication', enabling a device to know you're you – and on a continuous basis – without having to initiate it.

Emotion recognition could be the real interesting one – Gartner gives three next-gen use cases here. First, online shopping apps could detect a shopper's interest by monitoring facial expressions, presumably to auto-changing offers or products displayed on the fly. Second, it could be used to auto-adjust game level difficulty, again by monitoring the user's tension levels. Third, car manufacturers or insurance companies could "utilise the front camera on a smartphone to understand a driver's physical condition or gauge stress and fatigue levels" as a means to "increase safety".

SAY GOODBYE TO PRIVACY?

These are all contained in a new Gartner report entitled 'Market Insight: 10 Use Cases for AI-Powered Smartphones to Generate New Business Opportunities'. In outlining the report, the authors state that "the inclusion of automation and personalisation via AI functionality in smartphones will continue to test users' level of trust over their desire for real-time and personalised interactions". We're used to handing over supermarket shopping data in the form of loyalty cards, but how much of your personal life are you willing to hand over to businesses? On one level, insurance companies could offer lower premiums to consumers who provide continuous data – at that point, you'll have to decide how much your privacy is worth.

It's another huge issue beyond our scope here, but the apparent willingness of tech-native generations to hand over their privacy with seemingly little or no question is not without future risk. There is much academic research occurring in data anonymisation, the science of making data anonymous without removing the information, but if you've already signed over your rights to privacy by not reading end-user license or product disclosure agreements, it's all a moot point.

One benefit of future phones bringing AI onto phone hardware is greater security and privacy. When given permission, current phones act more like data-gatherers – data is captured and sent to the cloud for processing. By bringing AI onto the phone, you can create a local closed system, which should improve security and privacy.

Artificial intelligence and machine learning offer huge potential, particularly in medical research where it's used in everything from cancer research to understanding brain diseases, such as dementia and Alzheimer's. But as smartphones continue to improve their ability to perform AI, we're reaching a tipping point, particularly where businesses have greater access to our personal data. It's not a topic that seemingly interests many, but knowing who has access to your personal data and for what purpose needs to become a skill we all nurture.

NATURAL-LANGUAGE UNDERSTANDING

If the recent 2018 Consumer Electronics Show (CES 2018) is a guide, voice-controlled smart assistants are laying the groundwork for the next consumer tech revolution. Google and Amazon are hard at it to expand their respective voice-AI tech into new areas (such as LG's new next-gen OLED TVs). However, in both cases, Amazon Alexa and Google Assistant rely on cloud processing for speech recognition. As the numbers of voice-AI devices ramps up, that'll increase pressure on existing internet infrastructure. It will make local mobile assistants pretty attractive, by cutting or reducing network reliance. Faster AI could also help with context recognition. Recognising speech is really the 'version 1.0' of smart assistance tech. Understanding the context in which something is said is high-order intelligence.

COGNITIVE HEALTHCARE

One area not mentioned in the report but one in which we see significant opportunities is what we'd call 'cognitive healthcare'. As we've mentioned, AI is a significant player in health research and the ability of AI to augment healthcare treatment – whether it's 'hyper-personalised' (a treatment plan devised specifically for you) or remote treatment – is being increasingly sought. As the cost of healthcare continues to skyrocket, there's plenty of research into and interest in health-tech and the possible benefits of applying artificial intelligence.

One example of this is using machine-learning to improve overall accuracy in making diagnoses from medical imaging. As smartphone imaging continues to improve, it's not inconceivable that phones will eventually become portable medical diagnostic tools in their own right. It's unlikely we'll see this in the next five years – but still, as we all know, five years is a long time in tech.

Make your own IoT projects with a WeMos D1 Mini

The WeMos D1 Mini gives you 802.11n Wi-Fi, 32-bit architecture and up to 160MHz clock speed — and you can code it with the Arduino IDE. Darren Yates explains how.

Espressif Systems' ESP8266 Wi-Fi chip has revolutionised the Internet of Things (IoT) for homebrew projects over the last few years. Packing in a 32-bit microcontroller chip with 4MB of flash storage, it's not only capable of running Python code, it can also be cranked up from its stately 80MHz clock speed to a turbo-charged 160MHz. It's been used in a wide range of development boards, many of which can be coded using the standard Arduino IDE. However, if you're looking for the most versatile version that's compact, breadboard-friendly and well-supported, the WeMos D1 Mini is the answer.

BREADBOARD-FRIENDLY

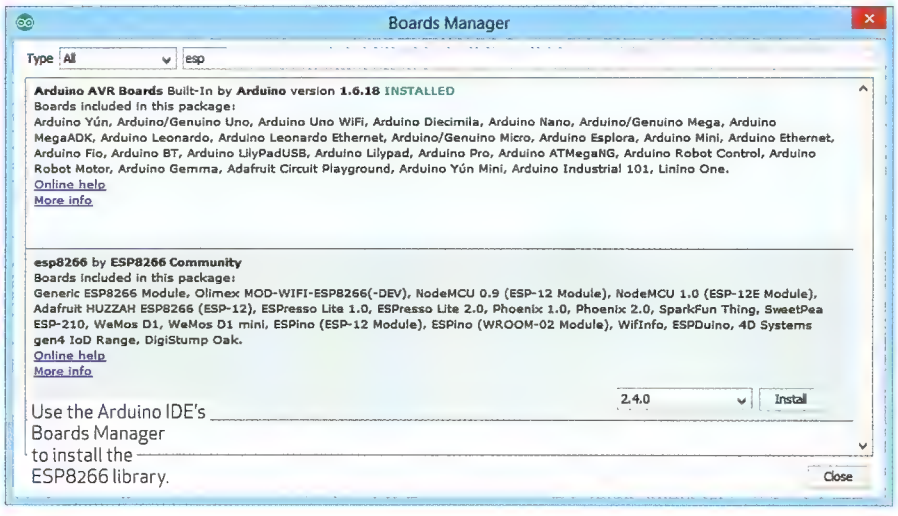
It might seem an odd point to push, but the D1 Mini is one of the few simple breadboard-friendly versions of the ESP8266 around. Breadboards are the ideal way to experiment with development boards, allowing you to create and change your own circuits with ease. We've looked at one or two NodeMCU-grade open-source boards, which fit in a standard breadboard, but they leave no room for wire connections. None of the original ESP-series boards were designed for breadboard use, either. By contrast, the D1 Mini leaves a row of pins on each side when centrally installed, making all pins easy to access. Physically, the D1 Mini is about the same size as a standard SD card.

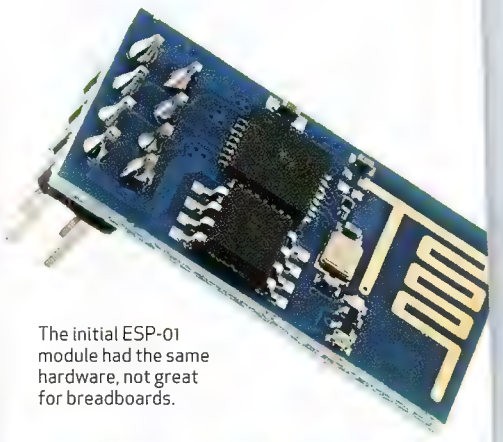
CRANKING IT TO 160MHZ

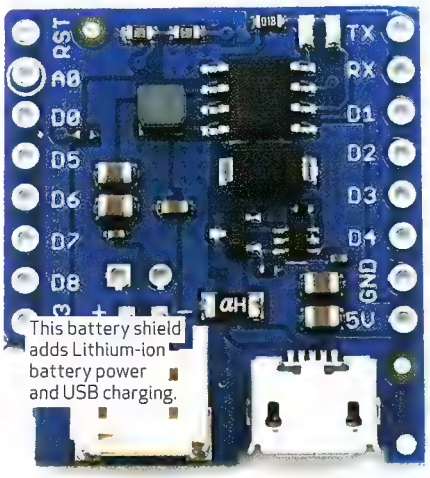
When you're used to playing with an Arduino Nano or Uno board clocking at 16MHz and offering just 8-bit architecture, having a 32-bit microcontroller with 160MHz clock speed can really put the wind back in your sails. But to get that wind, you need to set the clock speed manually in your Arduino IDE before you flash your source code to the board. The ESP8266 defaults to an 80MHz clock rate – the 160MHz option isn't an overclock, it's a genuine setting. However, it does chew through more electrical current – that's a normal trade-off, so if you're running the board on battery power and you don't really need the speed, stick to 80MHz. However, to get the turbo rate, you need to set it in the Arduino IDE before flashing your source code across. Here's how.

First, from the IDE menu, select 'Tools > Board' and then 'Boards Manager' from the context menu. Type "esp" into the search bar and select the 'esp8266 by ESP8266 Community' library entry. Next, click on the Install button.

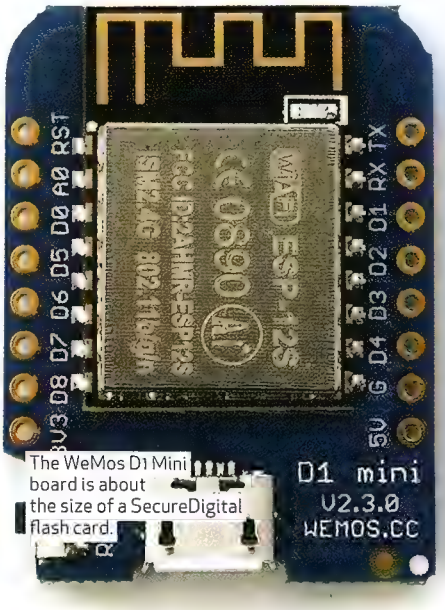
Once the hardware library is installed, plug the D1 Mini board into


Boards Manager
Type All esp
Arduino AVR Boards Built-In by Arduino version 1.6.18 INSTALLED
Boards included in this package:
Arduino Yún, Arduino/Genuino Uno, Arduino Uno WiFi, Arduino Diecimila, Arduino Nano, Arduino/Genuino Mega, Arduino MegaADK, Arduino Leonardo, Arduino Leonardo Ethernet, Arduino/Genuino Micro, Arduino Esplora, Arduino Mini, Arduino Ethernet, Arduino Fio, Arduino BT, Arduino LilyPadUSB, Arduino Lilypad, Arduino Pro, Arduino ATMegaNG, Arduino Robot Control, Arduino Robot Motor, Arduino Gemma, Adafruit Circuit Playground, Arduino Yún Mini, Arduino Industrial 101, Linino One.
Online help
More info
esp8266 by ESP8266 Community
Boards included in this package:
Generic ESP8266 Module, Olimex MOD-WIFI-ESP8266(-DEV), NodeMCU 0.9 (ESP-12 Module), NodeMCU 1.0 (ESP-12E Module), Adafruit HUZZAH ESP8266 (ESP-12), ESPresso Lite 1.0, ESPresso Lite 2.0, Phoenix 1.0, Phoenix 2.0, SparkFun Thing, SweetPea ESP-210, WeMos D1, WeMos D1 mini, ESPino (ESP-12 Module), ESPino (WROOM-02 Module), WifInfo, ESPDuino, 4D Systems gen4 IoD Range, DigiStump Oak.
Online help
More info
2.4.0
Install
Close
Use the Arduino IDE's Boards Manager to install the ESP8266 library.


The initial ESP-01 module had the same hardware, not great for breadboards.



This battery shield adds Lithium-ion battery power and USB charging.



The WeMos D1 Mini board is about the size of a SecureDigital flash card.

a USB port, go back to the Tools menu, select Board again, but this time, scroll down until you see the 'WeMos D1 R2 & Mini' entry and select it. Now for the third time, select Tools from the main menu and you'll see a new context menu list. On this occasion, choose 'CPU Frequency' and you'll have the option to select 80MHz or 160MHz. Choose 160MHz and you're done. Just remember that your board and its code will run at this clock speed until you change the CPU frequency option again.

HOW THE D1 MINI WORKS

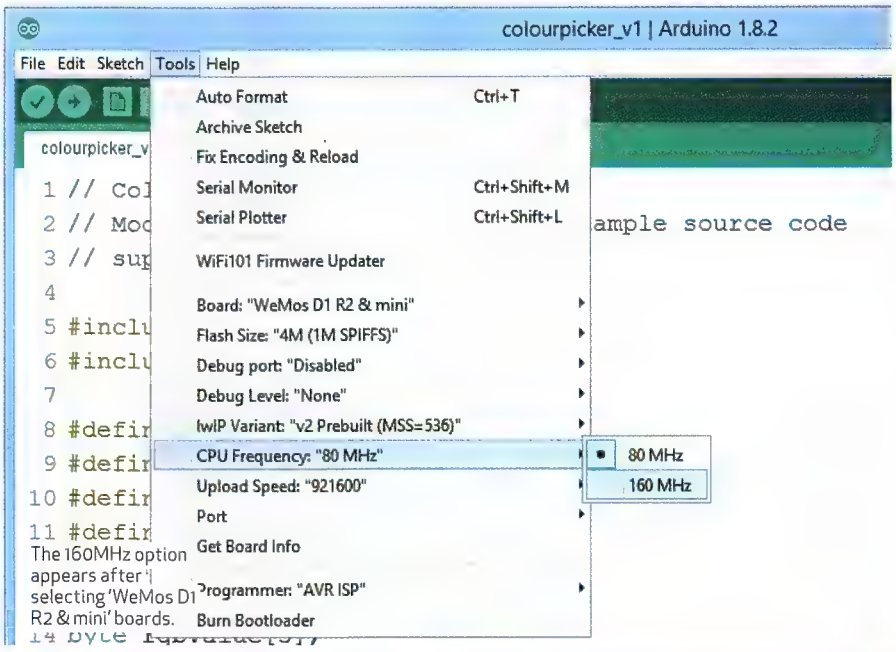
The original ESP-01 module was extremely compact, but offered no USB connection, wasn't breadboard-friendly and hid most of the ESP8266 chip's features. The NodeMCU boards fixes up the majority of those issues, but its size makes it difficult to use, whereas the D1 Mini keeps almost all the features, but in a smaller form factor.

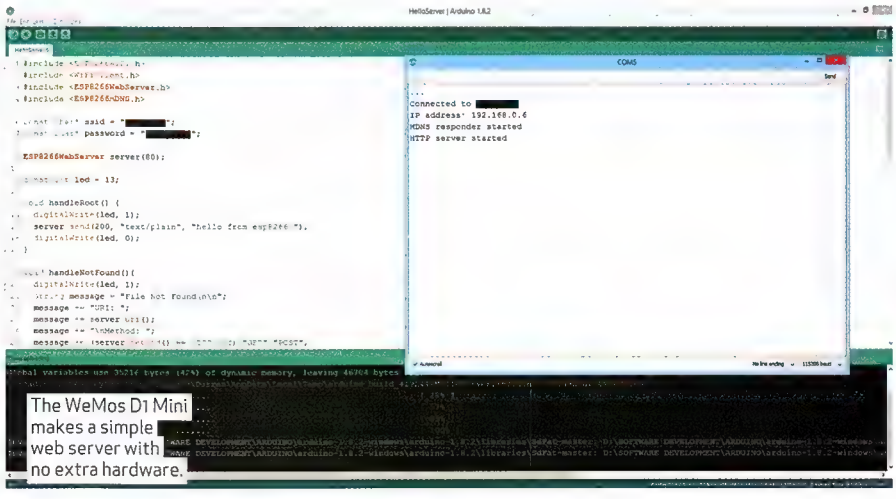
The ESP8266 chip doesn't have an internal USB driver, so like most development boards, the D1 Mini adds the ubiquitous CH340G USB chip. Otherwise, the D1 Mini simply breaks out as many of the pins from the canned ESP-12S module as it can. Inside the ESP-12S module is the ESP8266 Wi-Fi chip, plus a 4MB flash storage chip. Together, they store and run your code. The D1 Mini board breaks out 11 digital input/output pins from the ESP8266 chip along its two edges, plus the chip's 10-bit analog input. The ESP8266 actually has 16 digital I/O pins, but losing some is the cost of a compact board. The chip is designed to run at 3.3 volts and gets this from the 5-volt USB using a voltage regulator. The D1 Mini board still offers both 5-volt and 3.3-volt output pins for use, although the '3V3' pin can only supply limited power.

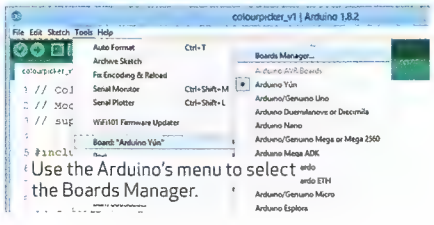
There are also no extraneous LEDs to worry about – only the blue LED on the ESP-12 module, which also serves as upload indicator when flashing your source code across.

SD CARDS AND I2C

Like most Arduino boards, there are a number of pins on the D1 Mini that do double-shift – digital I/O pins D5 through D8 also provide a four-pin serial peripheral interface (SPI) bus, to which you can connect up a simple microSD or SD card reader. The SPI bus isn't quite as good as a genuine Secure Digital Input/Output (SDIO) bus – it's not as fast for a start – but it'll do the job. The other bonus is the ESP8266 chip runs at 3.3 volts, the same as SD and microSD cards, so there's no need to lob in a voltage regulator.




The WeMos D1 Mini makes a simple web server with no extra hardware.


Use the Arduino's menu to select the Boards Manager.

It also has a two-pin inter-integrated circuit (I2C) bus located on board pins D1 (SCL) and D2 (SDA). This makes it useful for driving those small 0.96-inch 128 x 64-pixel OLED display panels, not to mention anything else you may need an I2C bus for.

Last but not least, there's a tiny side-mounted pushbutton reset switch near the microUSB port to wake up a dead board or simply to restart your code.

BREAKOUT SHIELDS

The WeMos team has also gone a step further, providing a range of adapter boards or 'shields' that can stack on top of the D1 Mini, similar to the Arduino Nano, but with a smaller form factor. There's a decent range of shields as well, including OLED display, DC power (for using a power brick), plus a Lithium-ion battery charger for taking the D1 Mini off-site. There's even an SHT30 shield that provides temperature and humidity sensing, although we reckon you'll learn more by making your own weather tech setup.

EASIER THAN YOU THINK

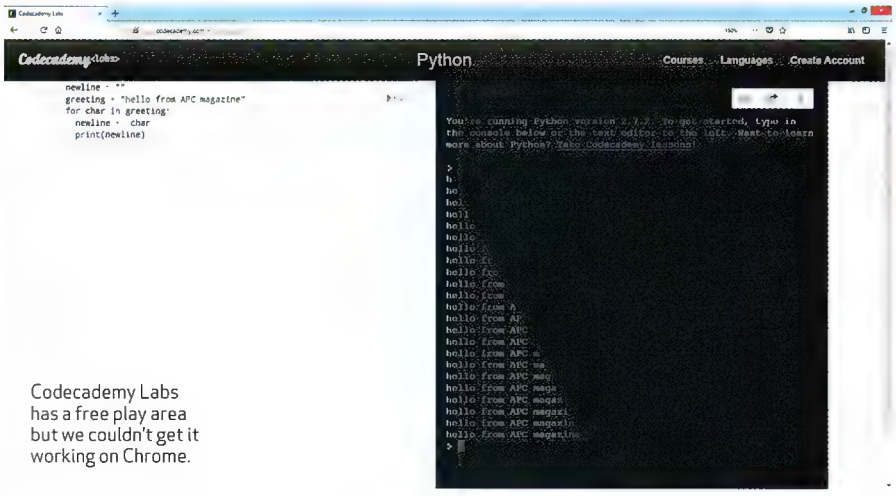
Even though it has been superseded by the newer ESP32S chip that adds Bluetooth BLE to its Wi-Fi stack, the ESP8266 is still an excellent and popular chip because it makes adding Wi-Fi, and hence IoT functionality, to your projects remarkably easy to do.

Whether you choose to try out the WeMos shields or simply choose your own components via breadboard, the WeMos D1 Mini is easily the best Wi-Fi maker board we've seen so far. And for as little as $5 online, it's also one of the cheapest. ■

Code Python apps in your browser

Have a locked-down PC you can't install apps on? No worries — code Python apps in your browser instead. Darren Yates explains how.

Python is a fun and easy programming language to learn that installs easily on your PC – that's unless you're running a computer that won't let you install your own software. With many schools and businesses locking down their machines to within an inch of their life to minimise security risks, it's not an uncommon problem. But if your computing device includes a solid web browser, you're back in business – just code Python via your browser.



Codecademy Labs has a free play area but we couldn't get it working on Chrome.

PYTHON ON A BROWSER

With schools getting on-board the STEM bus and looking to offer programming lessons, there's a mini-boom happening in browser-based Python coding solutions. Whether you're happy to pay or looking for freebies, whether you want something that's cloud-based or a solution that runs entirely on your computing device, there's no shortage of options available.

Some options emulate the standard code editor and console windows, while others will even allow you to create simple GUI apps within your browser. The thing to remember with almost all of these options, however, is the limited Python package access – most offer only a small selection of popular modules at best, such as numPy and SciPy.

However, you'll find most offer the majority of Python's basic nuts and bolts, so if you want to teach or learn Python coding online, there are a number of options available.

PYTHON 2 OR 3?

This isn't a question we've covered often, simply because it wasn't relevant through our Masterclass series, but if you find yourself having to ask which version of Python you should learn, we'd recommend Python 3. As the Python Wiki neatly puts it, "Python 2.x is legacy, Python 3.x is the present and future of the language". Given Python 2 hasn't seen a major update since 2010, it's interesting that some online Python coding sites only support Python 2.x. In other cases, you get access to Python 2.x for free, but have to pay for Python 3.x.

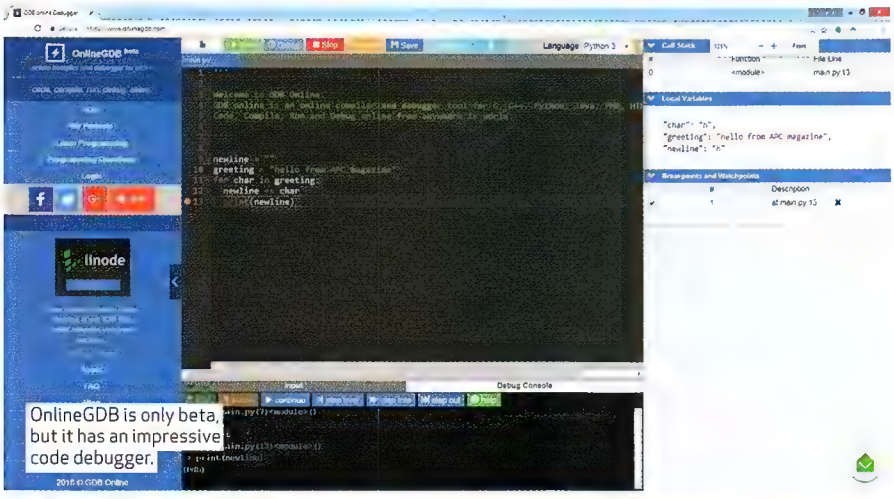
If you're just learning Python, we recommend you stick with Python 3 options only. The only reason to use Python 2.x these days is to access a library that isn't available for Python 3, in which case, you should probably know what you're doing already anyway. With that in mind, here's where you can code Python online.

CodeSkulptor provides a light user interface with simple graphics.

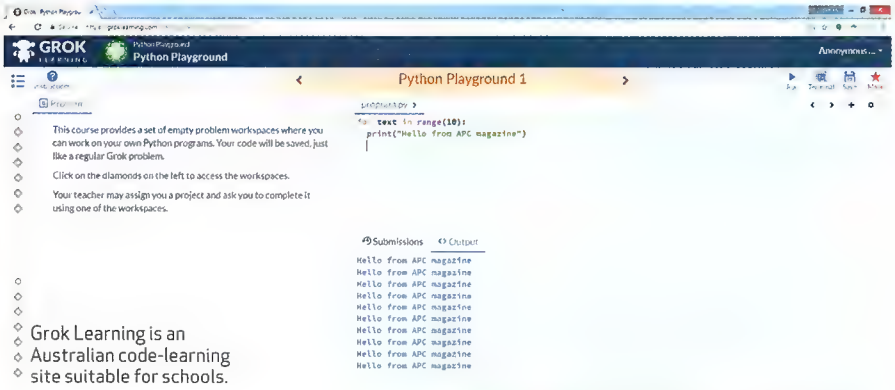
GROK LEARNING

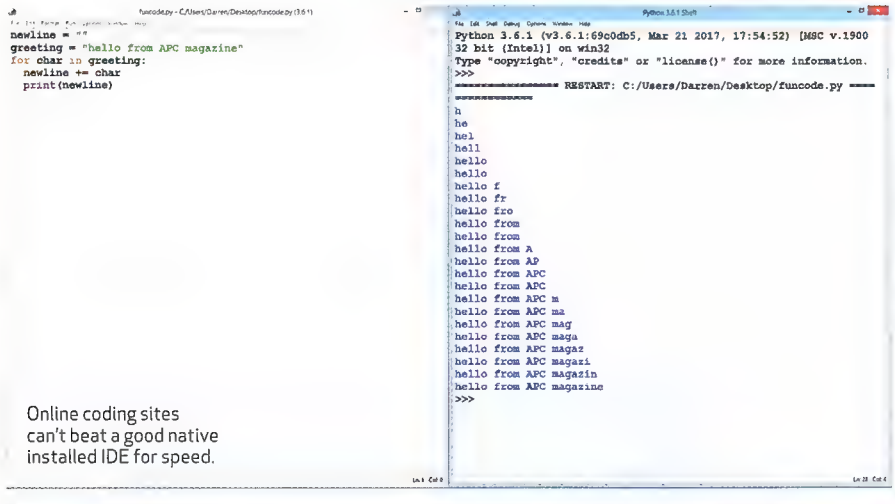
WWW.GROKLEARNING.COM

We'll start with 'home-grown' and this group called Grok Learning. It's run by academics from the University of Sydney and is designed for teachers and students. One of the key features Grok Learning includes is the ability to set assignments and keep track of student progress through virtual classrooms. It's not unique to Grok Learning, but an important addition. Access is mostly payware, with access to Python learning modules to learn you as you go. However, you don't have to sign up to try it out – just select an anonymous account and you can go through the first part of the 'Introduction to Programming (Python)' course. You can write code in the online editor, see the results in the console, even save your code in the cloud. It teaches Python 3, which we think is the right way to go (unlike other online options we've seen). You can also access the 'Python Playground' area, a free sandpit for

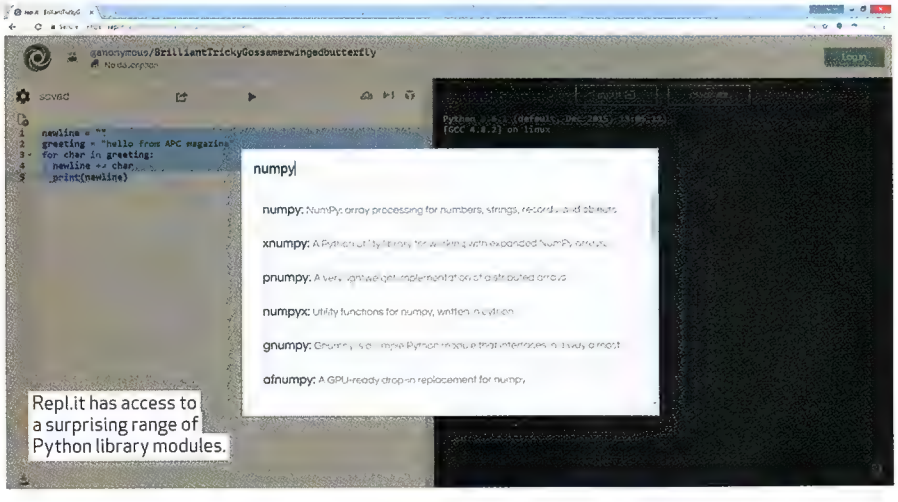


OnlineGDB is only beta, but it has an impressive code debugger.


GROK
Python Playground
Python Playground 1
This course provides a set of empty problem workspaces where you can work on your own Python programs. Your code will be saved, just like a regular Grok problem.
Click on the diamonds on the left to access the workspaces.
Your teacher may assign you a project and ask you to complete it using one of the workspaces.
Submissions
Output
Hello from APC magazine
Grok Learning is an Australian code-learning site suitable for schools.



Online coding sites can't beat a good native installed IDE for speed.



Repl.it has access to a surprising range of Python library modules.

writing your own code and doing your own thing.

For us, it doesn't seem as though the left-side instruction panel can be minimised, which would be a nice feature. We also prefer a side-by-side layout for the code and output windows, but that's probably just us.

Pricing is set at $5 per primary-school (up to Year 6) student and $30 per high-school (Year 7 and up) student. Pricing is per year. Teachers are offered free access.

If you prefer to teach Python your own way, we'd probably look at other options first, just for the sake of avoiding 'curriculum confusion', but if you're tasked with teaching coding and need a curriculum to go with it, that's where Grok Learning shines.

SKULPT

WWW.SKULPT.ORG

Compared with Grok Learning, Skulpt sits at the other end of the spectrum — it's completely open-source and completely client-side, meaning that it runs entirely in your browser. What's more, you can even set up your own website with Skulpt to enable Python coding. It runs Python 2.6, so you'll need to be aware of the differences between Python 2 and Python 3, but if you want a completely self-contained version of online-Python coding, Skulpt offers a lot of versatility and comes at a great price (it's free).

That said, if you're just starting your coding journey, this probably isn't the right option for you. It doesn't quite assume you're a Python Jedi Master, but it does assume you know what you're doing. If that's not the case, an option based on Skulpt you could look at is CodeSkulptor (see below).

The fact that Skulpt is completely client-side and open-source means you can also offer Python code to view and run on your own website. The Skulpt website gives you basic details on how to do it, including license details, either natively or through embedding using something like Trinket (see over the page).

TRINKET.IO

WWW.TRINKET.IO

If you'd prefer an option a little more in-between Grok Learning and Skulpt, trinket.io is well worth a look. The Trinket team has created this neat-looking user interface as a front-end for Skulpt, but has also gone the extra step and created versions for both Python 2 and Python 3. Both versions appear to support a fair selection of Python modules, including the usual suspects (numPy, matplotlib and so on).

While you can sign up for a free account, you can actually use it for

If you've outgrown IDLE, PyCharm is one of the best full-featured IDEs around.

"In terms of Python specifically, Repl.it has great support for a wide range of Python libraries, the best we've seen so far."

free and save your Python code as .py files on your device. However, it appears you only get access to basic Python 2 features – not the Python 3 code or modules. Getting access to all the goodies will cost you $9 a month or $72 a year.

Again, trinket.io follows the standard side-by-side editor and output windows layout, but the fact that you can embed your code into any HTML webpage offers plenty of creativity to educators. The user interface created is pretty decent and the left-side pull-out menu includes the option to send the embedded iframe into fullscreen mode, which is pretty cool. To restore the original view, you just press the escape key.

If you want to make your own custom learning website, trinket.io looks to be the easiest way to embed Python programming with a decent professional look.

REPL.IT

WWW.REPL.IT

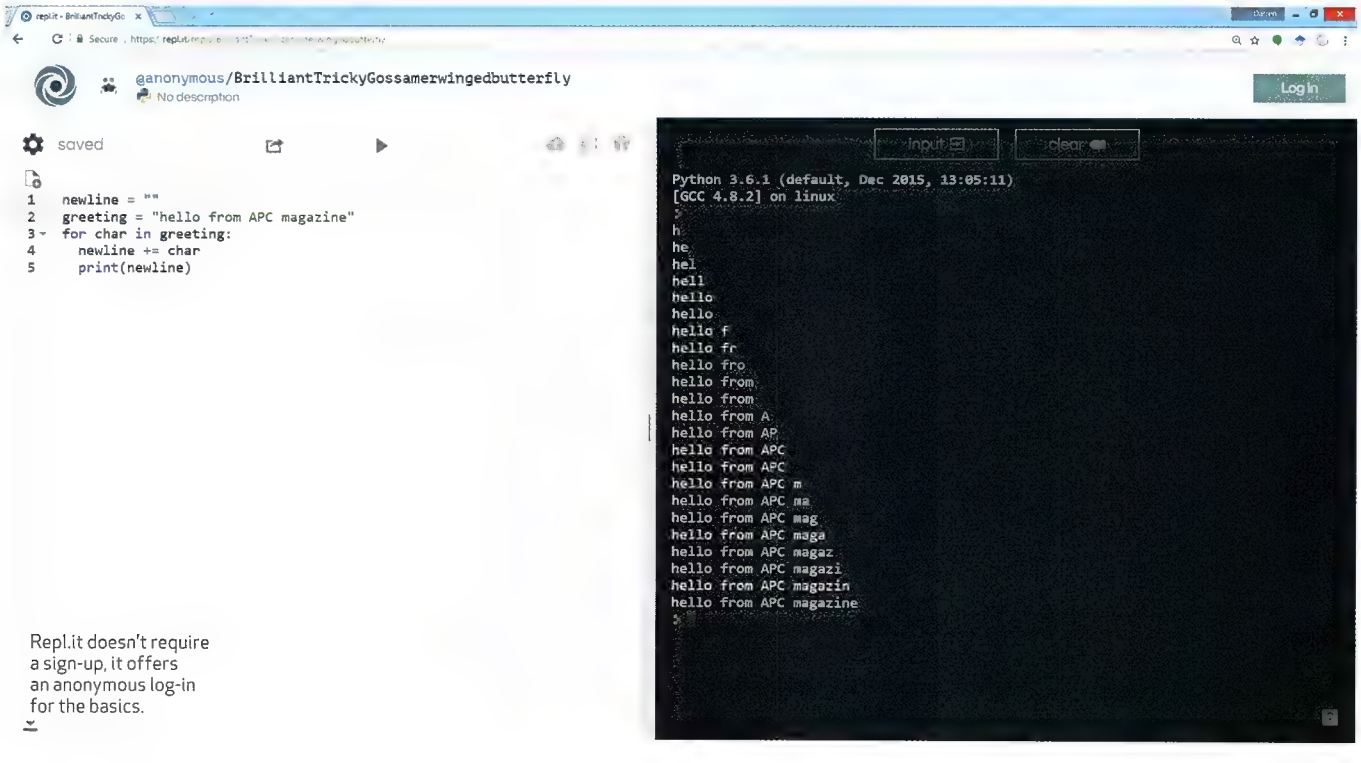
Of all the options we've discovered, Repl.it would be our favourite. We really like the simple and clean user interface, with side-by-side code and output windows – it just looks right. Aside from Python3 (a big tick), it also supports a pretty impressive array of programming languages, including C++, Java, Ruby, Swift and Haskell – nice. What's really cool about Repl.it is you can sign up for a free account and get good basic access to all those languages. Like Grok Learning, Repl.it also offers a special virtual private classroom setup that costs US$5 per student per year.

In terms of Python specifically, Repl.it has great support for a wide range of Python libraries, the best we've seen so far. Even better, if you just need to try out some quick-and-dirty Python code in a hurry, that's no problem either – you can quickly create an anonymous account. A solid installed Python-capable integrated development environment (IDE) is always the ideal choice, and given the array of languages supported, repl.it is only a server-side system, but failing that, it still gets the chocolates from us.

CODESKULPTOR

PY3.CODESKULPTOR.ORG

CodeSkulptor doesn't have what you'd call the most modern user interface you there, but it does have one incredibly powerful feature – and that's the fact that it's completely 'client-side', which means everything runs in your browser. Unlike most other options, it doesn't send your code off to the cloud to run and send you back the results – it actually runs in your browser. It's built upon the Skulpt project we looked at earlier, which provides the open-source brains executing your Python code.



Repl.it doesn't require a sign-up, it offers an anonymous log-in for the basics.

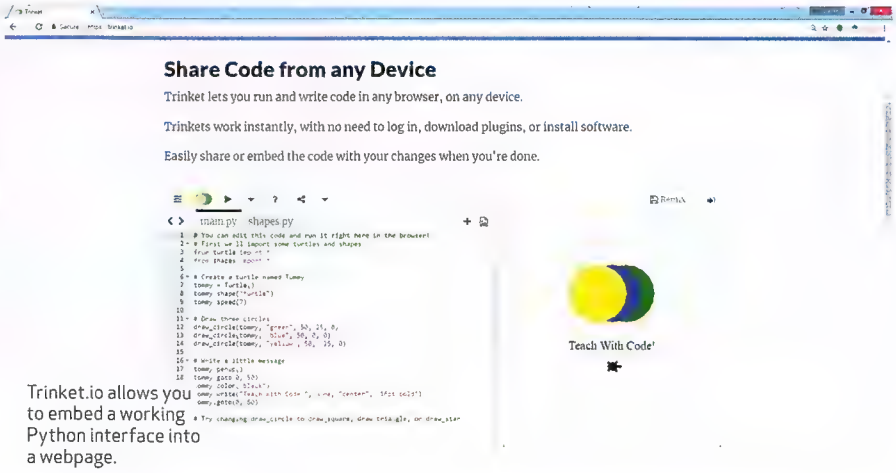
CodeSkulptor doesn't have the library support of something like repl.it, but it does have its own simple graphics modules (SimpleGUI, SimpleMap and SimplePlot) for creating more than just text apps.

Importantly, it's built on Python3, or what the developers call a 'subset' of Python3, which is a plus in our book; so too is the side-by-side code and output windows.

The documentation is reasonable, but it's not an all-inclusive learning tool like Grok Learning, for example, with built-in tutorials. Instead, CodeSkulptor was developed by academic staff at Rice University in the US and is used as part of the 'Introduction to Scripting in Python' course on Coursera, which includes 'Python Programming Essentials', an introductory subject.

If you're after a simple, no-nonsense Python editor that runs in your browser, CodeSkulptor is definitely worth a look — but only after you've had a play with repl.it.

Skulpt is the back-end for CodeSkulptor, best suited for experienced users.


Share Code from any Device
Trinket lets you run and write code in any browser, on any device.
Trinkets work instantly, with no need to log in, download plugins, or install software.
Easily share or embed the code with your changes when you're done.
main.py
shapes.py
Teach With Code!

Trinket.io allows you to embed a working Python interface into a webpage.

ONLINEGDB BETA

WWW.ONLINEGDB.COM

We're really torn by OnlineGDB Beta. On the one hand, it has a brilliant feature you'll find on few online editors — and that's a program debugger. Yet, on the other hand, we're not quite sure who'll use it. It'd hardly be a winning move to send your company's production code to a website for debugging (think of security for a start), but also, any decent IDE worth its code would have a decent debugger built-in already.

A debugger is a coding tool that lets you control and monitor the execution of your code, allowing you to step through and pause your code, as well as monitor variable values along the way. It's mainly designed to help you find nasty logical errors that can be tricky to find any other way. Achieving this in an online tool is damn impressive.

If you're teaching a 'Coding 201' subject and can't use a native installed IDE, this wouldn't be a bad interface to introduce the concept of assisted debugging. What's also impressive is that it can debug not just Python3, but C, C++, Java, PHP and HTML/Javascript/CSS code as well.

The interface itself is quite good — you can adjust font size and even enter command-line arguments to your code. It's also locked to vertical code and output windows, which isn't our cup of tea, but to have that debugger, you'd live with it.

All up, if you can't get to a native installed IDE, here's a way to learn (and teach) how a debugger works in a pretty easy-to-use setup.

CODECADEMY LABS

LABS.CODECADEMY.COM

Codecademy is one of the world's most popular code-learning websites, where you can learn the basics of a number of coding languages, including Python, Javascript, Java and Ruby and SQL. Typically, you have to sign up to get access to most features and a few courses are payware, but what's less obvious is that you can get access to a free play area. It's called 'Codecademy Labs' and it offers a basic side-by-side code editor/output window layout to toy around with your own code, even including some example code snippets to play with.

However, one drawback we found with Codecademy Labs is that doesn't seem to load correctly or run code in Google Chrome, yet played nicely in Internet Explorer 11 and the latest version of Firefox. Also, it only offers an instance of Python 2.7, not Python 3, from what we were able to find, so that's less attractive.

If you're already signed up to Codecademy, it's a neat little addition, but if you're looking from scratch, we'd probably try elsewhere first before choosing this one.

BETTER THAN NATIVE IDE?

Online coding tools are best used for learning in resource-limited applications, such as schools or when travelling and you feel the need to code. They can even be useful for showing off code snippets for blogs and just testing if you can remember how to create a Python for-loop.

We're certainly not suggesting for a minute that, if you're a professional programmer, you should start uploading production software code to some random website and save it online. Do that and you might as well go home, leave your front door open and put up a neon sign on your website that says 'hack me'.

Another potential downside of online coding is execution speed — Python is an interpreted language, so it's already not the fastest of languages, but running it on a browser that executes code via the cloud isn't exactly going to set speed records. That's why, ideally, you should always aim for a native, installed IDE first. It's just better.

Still, in the right context, online coding tools not only have their place, they can do a great job as a no-nonsense introduction to the awesome fun that is learning to code.

PC, PS4, XO | $99.95 | WWW.BANDAINAMCOENT.COM

Dragonball FighterZ

A fast-paced, engaging and easy-to-pick-up fighting game.

Dragonball Z games come out annually, and outside of a sizeable hardcore fanbase for that series, no one else seems to care. *Dragon Ball FighterZ* has been an exception though: rather than taking the usual light RPG brawler format, it's a fairly straightforward beat-'em-up in the mould of *Street Fighter*. So why has it become such a sensation?

Seeing it in action will partially answer that question. Arc System Works, the studio responsible for this instalment, is exceptionally good at making anime-centric games look like cartoons come to life. And that's exactly what *FighterZ* looks like. In fact, you could argue that *Dragon Ball FighterZ* looks better than the cartoons, its animations more fluid, its colour scheme more varied and vibrant.

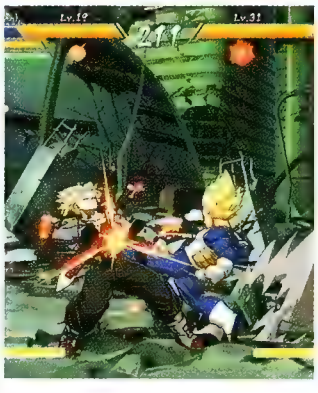
But it's also a great entry-level fighting game, the type that doesn't really exist anymore. With series' like *Tekken* and *Street Fighter* increasingly targeted at competitive, high-skilled players, *Dragon Ball FighterZ* is easy to pick up and mash away at. Sure, it contains all of the subtlety and depth that a hardcore fighter should, but it's also easy for two fairly average players to have a blast.

It's for the same reason the *Marvel Vs Capcom* games have been brilliant in the past (with the exception of 2017's quite mediocre *Infinite*). Every action seems to result in a flurry of obscenely over-the-top fireworks, and yet these flourishes don't steal away player agency: you still feel in control. Even during the most intense 3v3 matches – with each side swapping between their selected characters – the explosive animations still leave room for gameplay clarity.

Meanwhile, among the cast of characters in *Dragon Ball FighterZ*, you'll not be required to spend too much time learning each individually. Sure, they're all equipped with different skills and attacks, but the game prizes quick reflexes and decision making, rather than knowledge of the roster and how each individual character is played. Button presses are transferable across the different characters, and while they'll prompt different moves, you won't need to learn an encyclopaedia worth of arcane input orders.

Overall, this generation has sorely lacked a decent, entry-level fighting game that can also appeal to fanatics – especially if you're completely fed up with the DC universe (looking at you *Injustice*). *Dragon Ball FighterZ* can fulfil both desires, while also serving as eye candy for anyone else who happens to be in the room.

■ Shaun Prescott



Verdict

A brash, over-the-top and gorgeous fighter that will appeal to both the casual and hardcore alike.

★★★★☆

apc RECOMMENDS

There are plenty of weapons options, from ranged to heavy swords, but beginners should go with dual blades.

PC, PS4, XO | FROM $99.95 | WWW.MONSTERHUNTERWORLD.COM

Monster Hunter World

A complex but rewarding action RPG series goes big time.

This has long been one of the most popular RPG series in Japan, which is a surprise, given how complex it is. After a long period spent wallowing in Nintendo exclusivity, *Monster Hunter World* is Capcom's first attempt to bring the series to multiple platforms. Given the success of cooperative games like *Destiny*, now's a better time than ever to make that move.

The premise is simple enough: you're a hunter, your quarry is monsters, and that's about it. The truth is, these are eminently complex games, and while *World* blunts some of the more arcane elements of the series (mostly through streamlining the user interface), it'll still be confusing to most players. Tutorials are thorough and abundant, but for a generation of players accustomed to all modern blockbuster RPGs using the same systems, *World* will present a learning curve.

Once surmounted, though, what's unique and appealing about the series will shine through. Across each of the game's biomes roam unique and often terrifyingly huge monsters, and one must learn the strengths and weaknesses of each before daring to make an attack (or to trap the creature, which is also possible). Doing so in the company of friends is great (the game supports up to four-player cooperative), though it's possible to tackle the whole game on one's own.

Probably shouldn't try to hug the monsters, hey...

Though the best thing about *World* is that it simulates hunting expeditions: it's not your usual adventure RPG where you'll be moving from point A to Z during the game's duration. Instead, you'll hunt, stay fed, look after your material, upgrade your material (prepare to spend hours doing this), and go back to camp to take stock. There is a story narrative, and it does attempt to lend a sense of urgency to proceedings, but *Monster Hunter World* is a strangely meditative game: even the combat is paced slowly, though that's not to say it isn't challenging.

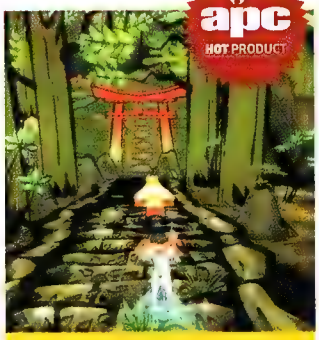
If you're after a game to invest hundreds of hours into, you can't go wrong with *World*.

■ Shaun Prescott

Verdict

A complex but deeply rewarding experience, either by yousrelf or with a couple of mates.

★★★★☆



apc HOT PRODUCT

Okami HD

A cult favourite gets a makeover.

PC, PS4, XO, PS3, PS2, WII
$49.95 | OKAMI-GAME.COM

If you can sit through the intro without fidgeting, you're perfectly qualified for the sweeping, serene-paced saga that follows. *Okami* is not a game you can play in bite-sized pieces, but rather one to clear long evenings and weekends for. It's arguably indulgent to a fault: and goodness, it's beautiful. The HD treatment means it looks a little crisper, but it mostly serves as a reminder that gorgeous, distinctive art design will always outlast attempts at photorealism. This folkloric vision of Nippon is a world of thick, inky lines and great washes of colour. At first, however, they're murky and muted: the land has been blighted by the return of an ancient demon and, as a white wolf inspirited by the sun goddess, you're asked to sort things out. With the help of a divine brush, you can physically paint over the bad stuff in the world. *Okami* feels refreshed. It's locked at 30fps, which suits the game but will no doubt disappoint some. Beyond that, it offers a range of resolutions, up to 4K, but not much else besides. If you're more of an explorer than a fighter, don't worry: combat is rarely a roadblock, and many encounters are optional. And away from the critical path, there's plenty to find.

■ Chris Schilling

★★★★½

Shadow of the Colossus

Attack on titans.

PS4 | $54.95
PLAYSTATION.COM/SHADOWOFTHECOLOSSUS

Shadow of the Colossus is often described as the 'Citizen Kane of video games', and not just because the two properties share a fascination with taking down larger-than-life figures. At the time of its 2005 release, it was the artistic watermark by which all other games were judged, and we're happy to announce that it still packs the same emotional punch and epic scope in 2018. Team Ico's masterpiece has received an astonishing remake worthy of its enduring legacy, with the Austin-based Bluepoint Games rebuilding the Japanese classic from the ground up, bringing cutting-edge visuals and modern controls to it in the process. *Shadow of the Colossus* looks especially great when played on a PS4 Pro, with the console's additional rendering power offering the choice to play at either 4K resolution or a rock-solid 60fps. A brand-new lighting engine also makes the game shine, especially when on an HDR-capable television. But for all the remake's bells and whistles, it's the journey itself that continues to resonate the most.

■ Stephen Lambrechts

★★★★★

PC | US$30 | WWW.SEVEN-GAME.COM/EN

Seven: The Days Long Gone

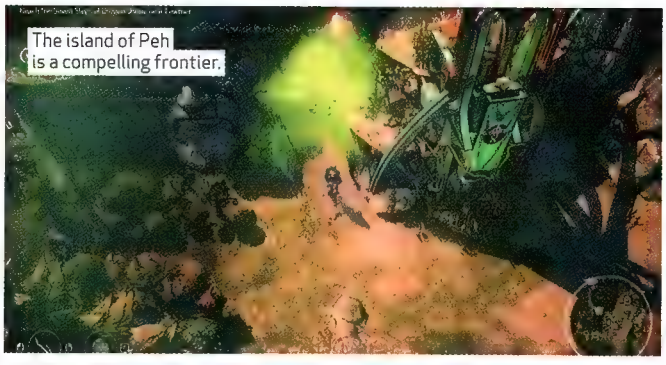
Thief's paradise.

This game is a smorgasbord of genres and settings colliding to create something uniquely unusual. A real-time isometric RPG, stealth sandbox, post-apocalyptic sci-fi universe with just enough mysticism to make it fantasy-adjacent – there's a lot to digest.

Seven is a game about being a sticky-fingered thief named Teriel. A master crook, Teriel finds himself shunted off to the prison island of Peh to be a god-like emperor's newest undercover agent. His mission: search for an ancient hidden spaceship. Oh, yes, and he's been bonded to a daemon.

In *Seven*, a thief is not a class – it's Teriel's career. So it's not a set of specific abilities, nor does it limit the ways in which his myriad objectives may be completed. Most missions, whether they're incidental sidequests or one of the core objectives, offer up a multitude of tempting paths to venture down.

The moment you land on the island, you're largely able to do everything you can do even 30 hours in,


The island of Peh is a compelling frontier.

though not necessarily as effectively. Teriel's been around the block, so he's perfectly capable of throwing punches, slitting throats, climbing in windows and unlocking safes. New skills and fancy gear that you can steal, craft or buy still help a lot, of course.

Progression isn't tied to abstract concepts like experience points. Instead of levelling up, you beef up Teriel with skill chips and upgrades, which are scattered all over the island. So you can choose whether to use stealth, violence or magic, but you'll always need to be an explorer. The perspective is obviously a perfect fit for stealth, too. The top-down view makes it much easier to plot routes. It's equal parts stressful and exhilarating.

Unfortunately, *Seven* is plagued by some rather serious bugs – nothing game-breaking yet, though enough to indicate that *Seven* needed quite a bit more playtesting.

There are rough edges, then. Yet it's still an impressive game – weird and liberating and driven by players whims. A patch or two wouldn't go amiss, though...

■ Fraser Brown

Verdict

A brilliant stealth sandbox and unconventional RPG in one very ambitious, but buggy, package.

★★★★☆

One of the few licensed household names you will spot among the player roster.

PS4, XO | $99.95 | WWW.BIGANT.COM

AO Tennis

A set of unforced errors makes this one hard to love.

Coinciding with the commencement of the Australian Open, *AO Tennis* is a title with big goals. The sim claims to "set a new standard for what a tennis game can offer fans", and while it boasts 10 years' worth of shot data feeding into its AI system, and photo-realistic depictions of real-life players, the "most advanced tennis game ever produced" still has a lot of improving to do.

First of all, there's no tutorial, and while some may appreciate this 'learn as you go' style, the option for at least a training session to get a handle on the basics of playing would go a long way. The easiest place to start is in Casual mode. We lost our first three games playing as Angelique Kerber – doing her a great disservice as we ran from side to side like a headless chicken.

Controlling your shot direction is done with the same stick as player movement, meaning placement of your shots is a bit tricky. Your player will also show a great deal of lag and occasional moments of downright laziness in movement, too – allowing easy balls to cruise past without so much as lifting their racquets. Hardly the claim made by Big Ant Studios that "players behave as they would in real life". Additionally, while you can charge your returns for greater power, this is a bit hit-and-miss, resulting in some wildly-hit balls that go miles beyond the baseline.

Once we figured out that the drop shot was an instant winner, however, we started to win games, meaning we could start to have a bit of fun. We were puzzled to find no 'smash' or 'sprint' option in the button mapping, though, which haunted us time and time again as our opponent lobbed balls over our heads. The camera angles don't help here. This wouldn't necessarily be such an issue if there was an on-screen indication of a lob shot having been played, allowing us time to rush back towards the baseline. However, there is no such thing, meaning the lobbed ball is your opponent's equivalent of the insta-win drop shot.

Another issue we encountered was the lack of atmosphere from the crowd. As points stretch out into epic rallys, a natural crowd would begin to get excited and cheer, but it's very lacklustre here. Likewise, the eventual winner of the point would celebrate with extra feeling, but, sadly, they're as enthusiastic about an unforced error from their opponent as they are about winning the whole Australian Open. Compared with something like last-generation's *Top Spin 4*, *AO Tennis* is rather soulless.

We did appreciate the fact that players will make more noises of exertion as the game draws on, and how realistic those limited licensed faces look.

The devs have promised to continue to support the game into the future, and there are already patches to download, but at the moment, *AO Tennis* struggles to deliver on its bold claims.

■ Carmel Sealey

Verdict

A game with great potential is plagued with lag and design oversights.

★★☆☆☆

Bridge Constructor Portal

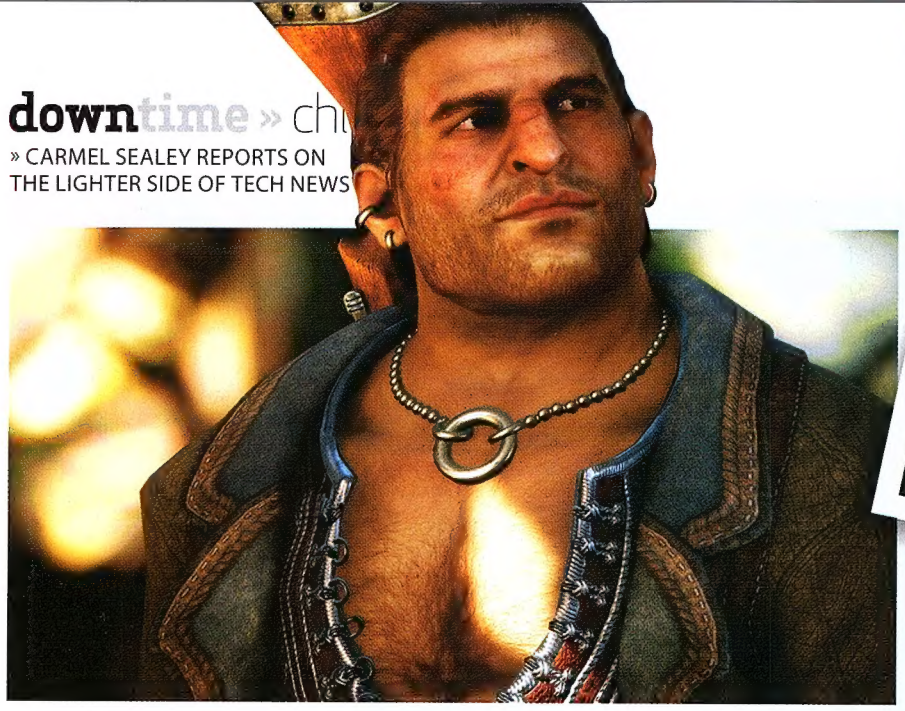
It's hard to overstate our satisfaction.

PC | US$10
WWW.HEADUPGAMES.COM

When we saw Headup Games was extending its *Bridge Constructor* series to include a stand-alone title in Valve's *Portal* universe, we could hardly control our excitement. *Portal* is a first-person puzzle platformer from 2007. Players might remember that its sequel, *Portal 2*, was teased with a series of trailers featuring charming animations of paper-cutout-style humans. It's these adorable humans and their trucks that we're building bridges for, but where the original *Bridge Constructor* had you creating roadways across chasms and rivers, the *Portal* iteration includes portals, turrets and deadly lasers. And we are pleased to report that the game is thoroughly challenging. To make your bridges, you first construct a scaffold, then convert parts of the scaffold into the roadway. You can also use cables. Unless you're an engineer, you will fail many times to make a successful bridge over a pool of acid, or misjudge a jump and kill people, but you can restart the level. If you're already a fan of the series, this one is undoubtedly the best one yet, adding new mechanics and a thoroughly suitable new universe in which to build. Prepare to be further enriched... by science (and engineering)!

■ Carmel Sealey

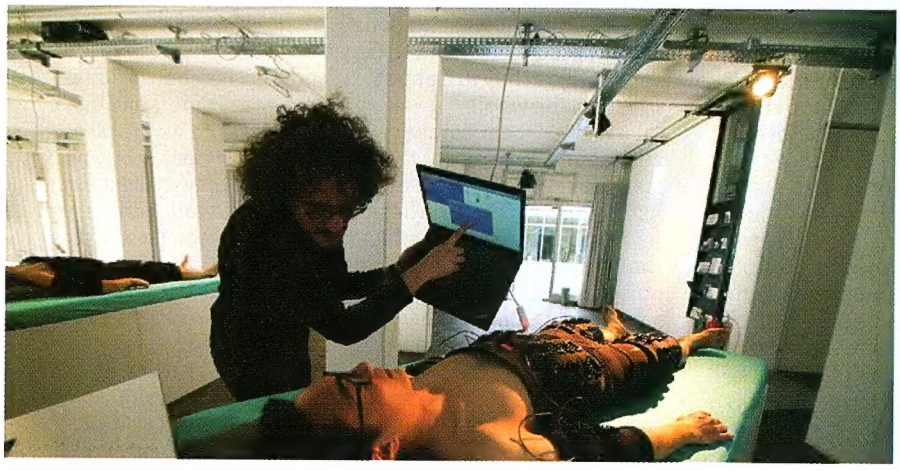
★★★★★



Dragon Age's 'Hard in Hightown' is about to get real

Fictional fiction writer gets publishing deal.

Varric Tethras is well known among fans of BioWare's *Dragon Age* games – largely for his wit, lies, writing prowess, his crossbow Bianca and his chest hair. But while many (your humble writer included) still despair over the fact that he is one of the few travelling companions that you *cannot* romance, there is cause for celebration – Varric's oft-referenced *Hard in Hightown* novel is going to be published by Dark Horse Books! The 96-page-long book will include 24 black-and-white full-page illustrations and, most likely, fleshed out chapters. The story, which heavily borrows from and pokes fun at characters from *Dragon Age II*, is a mystery set in that game's city of Kirkwall. The novel will be available from mid this year, and we're sure a copy will fall into our hands soon afterwards... *Sqweee!*



This suit can mine cryptocurrencies

AND JUST LIKE THE MATRIX, IT RUNS OFF HUMAN POWER.

Mining cryptocurrencies uses up a lot of energy, with a single transaction supposedly using the equivalent of 10 households' worth of energy over a whole week. The cheerfully named Institute of Human Obsolescence has created a more environmentally-friendly way to mine – powering it using human body heat. By getting workers wearing "a body suit that harvests their residual body heat" to lie down on 'workstations', the company was able to "produce electricity that then is used to mine". Their aim isn't to create a cryptocurrency-mining clothing brand; instead, they wish to spark a discussion "about the way humans relate to technology and the socio-political implications of the accelerated pace of undisciminated technological assimilation". ¯_(ツ)_/¯

Exercise-tracking app Strava inadvertently reveals military bases

COMBINED USER DATA SHOWS A BIT TOO MUCH.

Strava records a lot of info about its users, including very accurate exercise route data (which has been used to draw images on the map of things like Pikachu). Able to be run on a smartphone or in conjunction with a Fitbit, analysts noticed that military personnel were inadvertently giving away the location of military bases. Not only were they showing the precise position of said bases (something that's not visible on Google Maps), the GPS tracking is so accurate that the layout of corridors and perimeters can clearly be seen. Potentially very dangerous information right there, if it gets into the wrong hands. Strava has suggested that military personnel opt out of the heatmap to prevent this from happening in the future, while many other countries' military institutions are now calling for the app to be banned entirely.

Electric cars could sound like nu metal

ARTIFICIAL NOISES PENNED BY A BAND.

Since electric cars are practically silent, some regulatory bodies have decided that they should make artificial sounds for the sake of pedestrians. While Nissan has decided to create a song-like tone that changes depending on the speed, AMG has become "partners in performance" with none other than Linkin Park. The band is probably best known for its first two albums (you know, the good ones), which — together with bands such as Korn, Limp Bizkit, System of a Down and Disturbed — defined the sound of the charts in the late '90s and into the '00s. But while this might sound great (who wouldn't want their car trundling down the road sounding like the opening seconds of *Faint* or *Breaking the Habit*?), we doubt the end result will be that cool. ■

THE
MOST FUN
YOU CAN
HAVE WITH
YOUR HANDS
WITHOUT
GOING
BLIND

games radar.
MORE KICKS PER CLICK

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The home of technology

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